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PROGRESS REPORT

PROJECT CRITIQUES

SUPPLEMENT "A"

JANUARY, 1973

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INTRODUCTION

In Supplement A to "Progress Report, Project Critiques," projects owned by the Montana Department of Natural Resources and Conservation are summarized. In Appendix C of "Progress Report, Project Critiques," priorities are listed. Supplement A reviews all projects for which a pre-feasibility report is planned and one project for which a review report is planned. In the last section of this supplement, projects for which terminal reports are planned are also briefly reviewed.

The Montana Department of Natural Resources and Conservation (referred to throughout as "Department") was formed under the Executive Reorganization Act of 1971. The Department incorporated the Montana Water Resources Board, which was a successor to the State Water Conservation Board. Both Boards are referred to periodically in this supplement.

The following abbreviations, which are used throughout Supplement A require definition.

1. cfs -- cubic feet per second, a measure of stream discharge.
2. gpm -- gallons per minute, a measure of well discharge
3. M.I.-- miners' inch, a measure of stream discharge equal to 1/40 of a cubic foot per second.
4. O&M-- operation and maintenance, one type of charge for water projects.

While reading a particular project summary reference should be made to the appendices in the "Progress Report" to facilitate comparison of that project to others with regard to water charges, recovery of state investments, project critique priorities, etc. Some additional details are also available in the appendices on recovery of state investments (Appendix D), project water charges (Appendix E), water rights (Appendix F), and measuring devices (Appendix G).

Included in many project summaries are maps of the project and graphs of stage storage, stage-area curves for the reservoirs. The curves indicate the storage capacities and surface areas of the reservoirs for given elevations.

ACKLEY LAKE

Introduction

The main feature of this project is Ackley Lake, an offstream storage reservoir created by the construction of an earthfilled dam, which is located near Hobson in Judith Basin County, Montana. Water for the reservoir is supplied through a diversion canal from the Judith River and is then returned to the river through an outlet canal. Water is supplied through distribution laterals from the outlet canal and through private diversions in the Judith River below the outlet canal. The construction of the project, which was completed in 1938, was financed by a loan and grant agreement from the Public Works Administration, together with State Water Conservation Board funds. This project provides considerable recreational benefits as well as agricultural.

Water Purchase Contracts and Finance

There are currently contracts for 2,626 acre feet, and 5,266 acre feet could be sold. Therefore, 2,640 acre feet are available for sale. The charges for the water are $.80 for Principal and $1.20 for Operation and Maintenance, making a total charge of $2.00 per acre foot. The O & M charge includes a 20% increase in 1972 to start a reserve fund.

The book charge as of June 30, 1972, was $46,391.39. Water purchase contracts for future water sales are valued at $6,858.40, and there is a repayment contract with the Ackley Lake Water Users Association for $7,079.58. When these amounts are paid, there will be a total unsecured debt of $32,453.41. It is expected that new contracts will continue to be sold and eventually the unsecured debt will be paid by new water purchase contracts. Apparently the only reason that more water is not sold is lack of interest, for there are no physical hindrances to the additional water sales.

Water Rights

An appropriation of 4,000 miner's inches (100 cubic feet per second) from the Judith River was filed by the State Water Conservation Board on August 20, 1935 (Ref: Document #62272, Clerk & Recorders Office, Stanford, Montana).

Measuring Devices

The project has no measuring devices. However, because the Judith River is a decreed stream, the water commissioner measures the water that is supplied through the river. The Department maintains continuous recorders on the inlet and outlet canals.

Inspection Report

An inspection of the project was performed on October 10, 1972. The inspection report states that:

(1) The dam face may need riprap.
(2) The walls of the drop into the lake are chipped, and patching is needed.
(3) The outlet walls of the weir are cracking, and the backfill is eroded.
(4) The apron of the outlet of the dam is blanketed with sediment which should be removed.

The water users will repair the last three items, but further investigation and a design and cost estimate are required for the first item.

Recent Major Repairs

In 1962 a diversion dam was built in the Judith River, and canal cleaning, bentoniting and other repairs were performed. The total cost of this repair work, $8,460.00, was financed by the Water Conservation Board. A short time later additional work was performed on the diversion dam and financed with a $7,079.50 advance from the Water Board.

Engineering Data

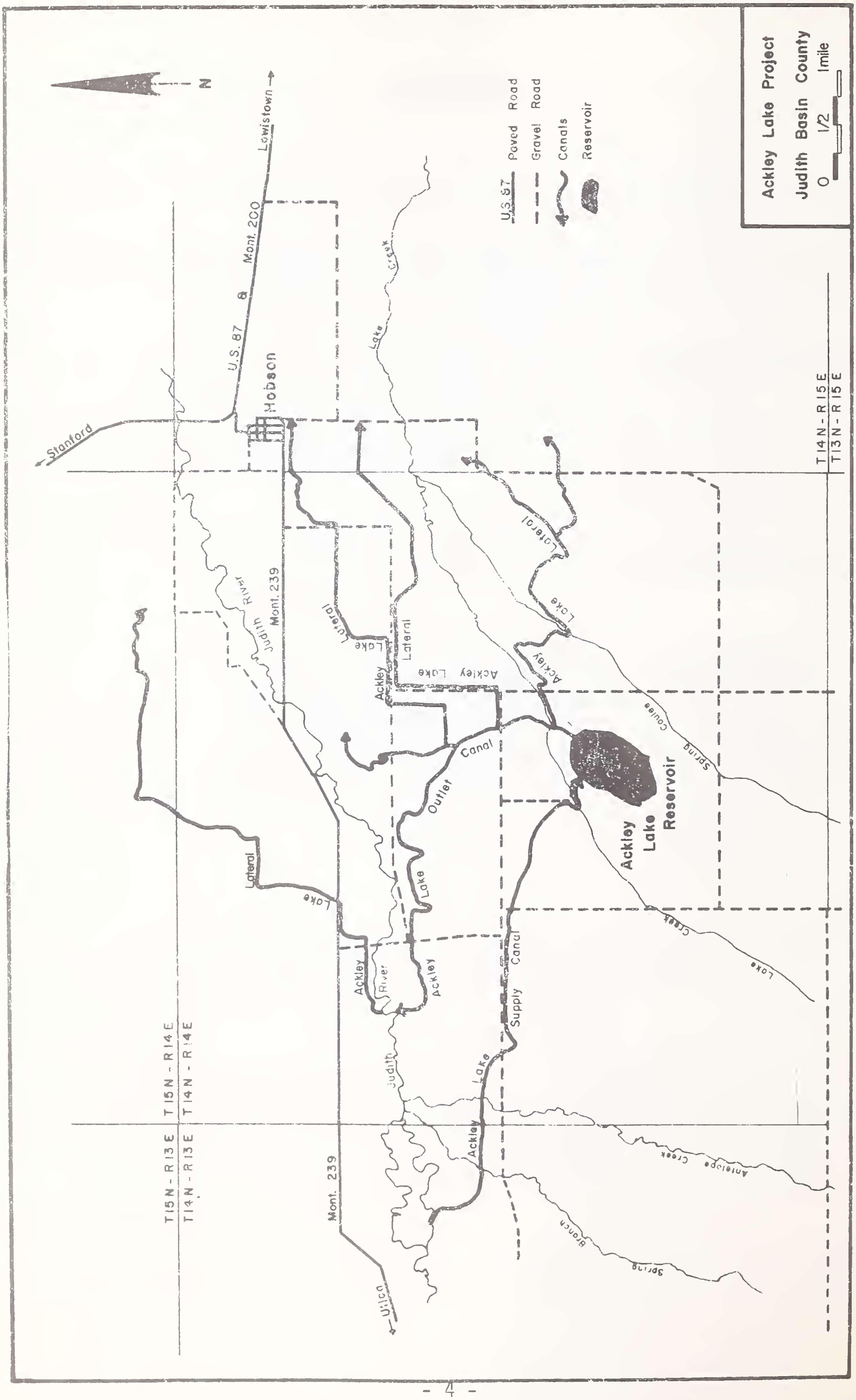
DAM:

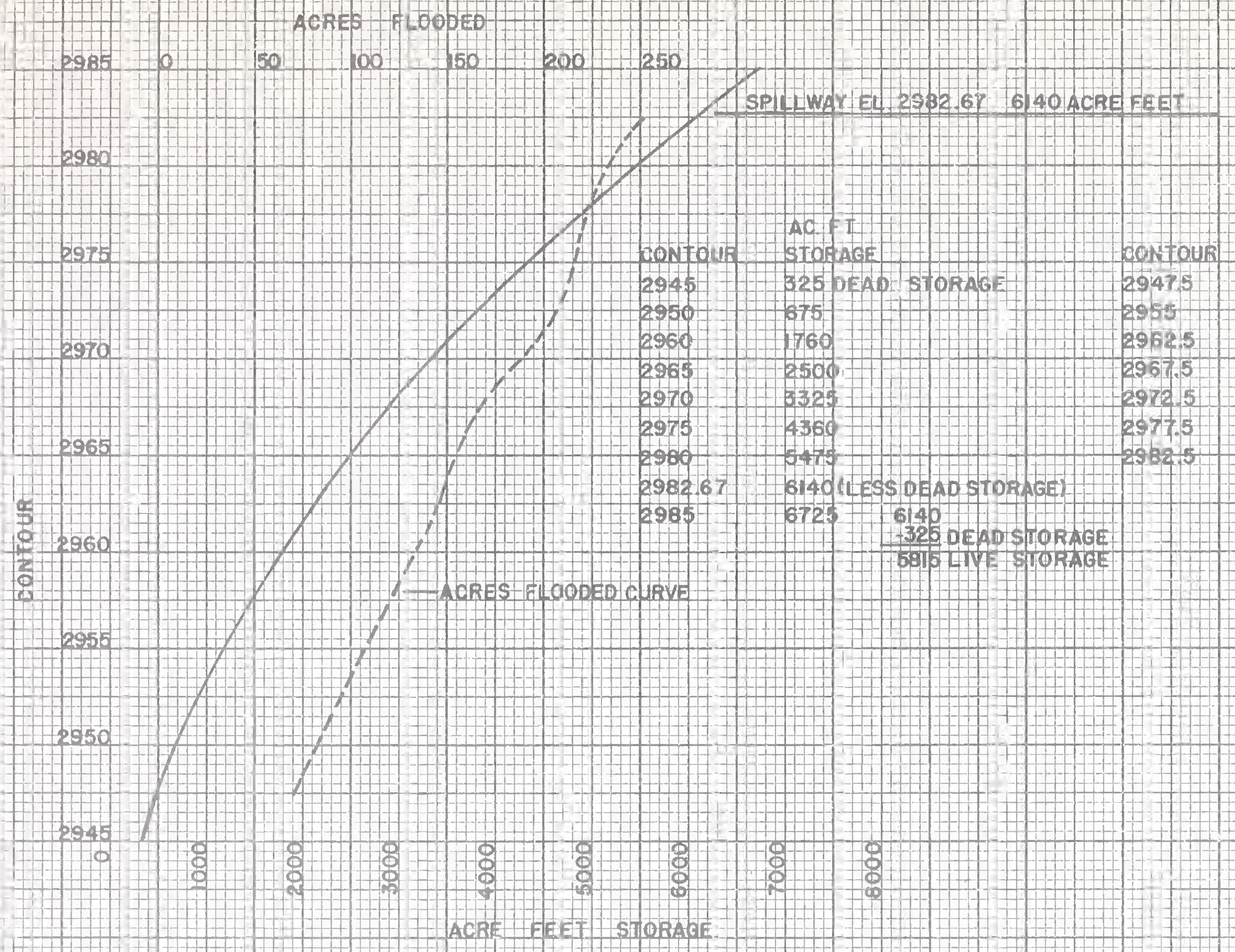
Storage:	5815 A.F.
Spillway:	Width 30' Capacity 200 cfs
Gates:	1 - 48" dia. Slide -- Wet Tower
Height:	41'
Length:	3,514'
Type:	Earth and Gravel Fill -- 108,000 cu. yds.
Content Measuring Device:	Tape in Control Tower
Initial Cost:	$174,410.47

CANALS:

Supply:	6.72 miles Capacity 100 cfs Concrete Headgate, Concrete Drop at Reservoir
Outlet:	4.68 miles Capacity 62 cfs
Measuring Device:	Water Stage Recorders above and below Reservoir

R/W	Reservoir Pool	250 acres deeded
	Reservoir Land	233 acres deeded
	Canals	129.17 acres deeded
	Laterals	17.6 miles easements

Ackley Lake Project
Judith Basin County
0 1/2 1mile
U.S. 87 Paved Road
Gravel Road
Canals
Reservoir
N
Lewistown
Stanford
Hobson
U.S. 87
Mont. 200
Mont. 239
Utica
Judith River
Lake Creek
Ackley Lake Lateral
Ackley Lake Outlet Canal
Ackley Lake Supply Canal
Ackley Lake Reservoir
Spring Coulee
Antelope Creek
Spring Branch
T15N-R13E
T14N-R13E
T15N-R14E
T14N-R14E
T14N-R15E
T13N-R15E



CONTOUR	AC. FT. STORAGE
2945	325 DEAD STORAGE
2950	675
2960	1760
2965	2500
2970	3325
2975	4360
2980	5475
2982.67	6140 (LESS DEAD STORAGE)
2985	6725

6140
-325 DEAD STORAGE
5815 LIVE STORAGE

CONTOUR	ACRES FLOODED
2947.5	70
2955	108.5
2962.5	148
2967.5	165
2972.5	207
2977.5	223
2982.5	250

ACKLEY LAKE

STORAGE CURVE

JUDITH BASIN COUNTY PROJECT NO. 277

BROADWATER - MISSOURI

Introduction

This project, located in Broadwater County, Montana, consists of a concrete diversion dam on the Missouri River and about forty-eight miles of canals. The initial capacity of the main canal is 342 cubic feet per second. The construction of the project was completed in 1940 and was financed with Water Board funds and a loan and grant from the Public Works Administration.

Water Purchase Contracts and Finances

There are currently contracts for 29,018 acre feet of water. The book charge as of June 30, 1972, was $100,884.52. At that time there were water purchase contracts for future water sales in the total amount of $132,590.93. With the present water purchase contracts the State will recover $31,706.41 over its investment. Detailed water measurements are now being made to determine whether more water can be sold. The charges per acre foot on this project are $.91 for principal and $.86 for Operation and Maintenance, making a total charge of $1.77. This is a reduction from previous years. A repayment contract, under which the water users were paying $.22 an acre foot, has been paid, so no special assessment was charged this year. The O & M charge had been $.76 for a number of years until 1972, when it was increased to $.91. In 1973 the O & M charge was reduced to $.86. The project has a small reserve fund, but the members of the Broadwater-Missouri Water Users Association are opposed to a new reserve fund as large as recommended by the Department, which is a fund equal to one year's O & M expenses.

Economic Analysis

Two recent reports included an analysis of the economic benefits of the project. "An Economic Analysis of Selected Montana State Water Conservation Board Projects" was published in 1964, and "An Ex Post Economic Evaluation of Montana Water Resources Board Projects" appeared in 1971.

The 1964 study, written by E. C. McDermott, included investigations of land prices, growth of banking and other businesses in the area, higher tax base, and general public reaction to the project. Some of his conclusions are as follows:

(1) Irrigation is of utmost importance to Broadwater County and is a stabilizing factor in assuring income from sale of cash crops and abundant winter feed.
(2) The Broadwater-Missouri Project is probably the most important irrigation project in the county. It serves approximately 15,000 acres.
(3) The project has made possible the production of such cash crops as sugar beets and potatoes, thus affording the water users an opportunity to increase their net returns per acre.
(4) Risk and uncertainty in crop production have been greatly reduced.
(5) The standard level of living of farm families in Broadwater County has has been relatively high during the past three decades as compared with the level of living of other farm families in the State and nation.

(6) The average value of an acre of irrigated project land was $193.22, while land of similar quality and fertility which could not be irrigated was valued at $19.06 per acre. The addition of water to the land has increased its value approximately $170.00 per acre. This difference in price should represent the capitalized value of the net returns to the water discounted over a period of time.

(7) The project has contributed considerably to the tax base of Broadwater County. If it is assumed that 25% of the 7,000 acres brought under irrigation by the project were previously classified as non-irrigated tillable lands, with the remainder designated as grazing land, then the increase in the tax base would amount to approximately $204,000.00. This consists of an average increase of $23.41 per acre on 1,750 acres and $31.12 per acre on the remaining 5,250 acres. Indirect additions to the tax base such as more farm machinery, equipment improvements, etc., would not be included, nor would the extent to which state income tax is broadened from the indirect and direct benefits.

(8) Net direct and indirect benefits from the project totaled approximately $620,000.00 in 1961. Based upon a conservative estimate of fifty year project life, and assuming net annual benefits equal those of 1961, then the total net benefits derived during the fifty year period would be approximately $31,000,000.00.

(9) Assuming the life of the capital structure to be fifty years and annual net return to be $620,000.00, the current value of the investment can be determined. At a discount rate of 4%, the current value would be 3.3 million; at 5%, it would be 11.3 million; and at 6%, it would be 9.8 million dollars. The total project cost was approximately 1.2 million dollars at the time of construction. In 1961 construction costs were approximately 4.5 times as great as when the project was constructed, making project construction costs in 1961 dollars equal to approximately 5.4 million dollars. This analysis indicates that this project has a very favorable benefit-cost ratio. At a 4% discount, the ratio would be 2.5 to 1; at 5%, it would be 2.2 to 1; and at 6%, it would be 1.9 to 1.

The second economic study, "An Ex Post Economic Evaluation of Montana Water Resources Board Projects," was written by Mr. Bill Turnquist, a WICHE intern. A sensitivity analysis was made to determine the likely range of economic benefits resulting from the Broadwater-Missouri project. Two ranges of benefits were used. The low range assumes a 10% increase in crop values on project land, and the upper range assumes a 50% increase. Several different interest rates are used to bring the cost and benefits to today's value. The following table gives the results:

The Range of Benefit/Cost Ratios with Sensitivity Analysis Based on an Ex Post Analysis from 1940 to 1970 Broadwater - Missouri Project

	i = 2%	i = 5%	i = 8%
LOWER ASSUMED BENEFITS	2.99	1.84	1.24
HIGHER ASSUMED BENEFITS	11.59	7.22	4.97

The preceding figures do not include secondary or extra-market costs or benefits, i.e., effects on general economic conditions, on the environment, and on community attitude and stability.

The local attitude toward the project seems to be good. Most people directly affected are pleased by the stability it brings and the opportunities it offers for diversification of crops. Those studying the project have found it to have a great deal of community support.

Water Rights

A water right in the Missouri River was filed by the State Water Conservation Board on June 28,1938, for a flow of 16,000 miner's inches (400 cfs).

Measuring Devices

Measuring devices approved by the Directors of the Broadwater-Missouri Water Users Association are required for all turnouts. A program of carefully measuring water delivered at each turnout was initiated in 1972 and will be continued in the future. The Department maintains two continuous recorders on the project.

Inspection Reports

Recent inspections have, in general, found the project to be very well maintained. The diversion dam seems to be in good condition. However, no investigations have been made recently beneath the water surface. This operation, possibly involving the use of cofferdams to dewater the site, must be done in the near future.

The first one mile of canal has a high seepage loss of 30% to 40%. A concrete lining for this portion of the ditch was designed, financing was arranged and bids for the lining were advertised. However, the low bid was higher than the Engineer's estimate and was more than the water users were willing to pay. Therefore, all bids were rejected, and the canal has not been lined.

During the summer of 1972 a graduate student from Montana State University studied the Broadwater-Missouri project under the WICHE intern program in order to write a preliminary critique. He noted very few structural problems and found the daily operation and maintenance practices to be adequate. As part of his report, a complete structural inventory was made. The condition of each structure was rated and its useful life estimated. Copies of this report are available from the Engineering Bureau of the Department.

Engineering Data

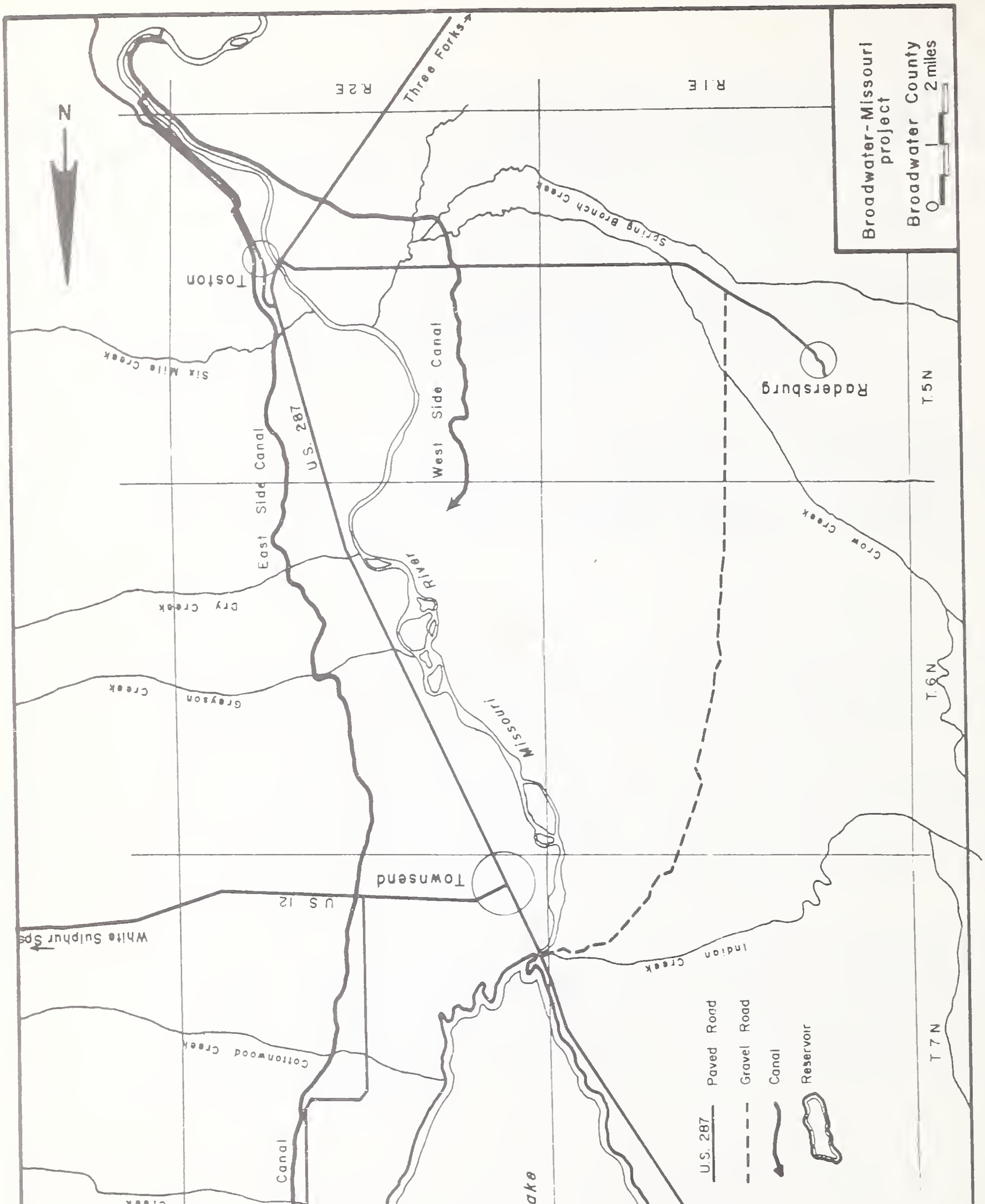
DAM:

Storage:	Direct Diversion
Spillway:	Width 375' Capacity 50,000 cfs
Gates:	4 - 48" x 84" Slide Headgate of Canal
Height:	40' Top of Gravity Section 56' Top of Retaining Wall
Length:	705'
Type:	Gravity Overflow with Stop Planks -- 14,047 cu. yds.
Content Measuring Device:	Staff Gage on Retaining Wall
Initial Cost:	$1,186,449.24

CANALS:

Main	1.5 miles Capacity 342 cfs Concrete Lined Section
West:	12.4 miles Capacity 90 cfs 1,445' of 54" diameter Siphon
East:	34.3 miles Capacity 262 cfs 666.6' of 84" diameter Pipe -- 454.9' in 4 suspended spans and 211.7' in ground. Crosses River and R.R.
Measuring Devices:	Water Stage Recorders

R/W	Diversion	49.18 Acres
	Main:	40.92 Acres
	West:	104.53 Acres
	East:	320 Acres


Broadwater-Missouri project
Broadwater County
0 1 2 miles
N
R.2E
R.1E
Three Forks
Toston
Spring Branch Creek
Radersburg
Six Mile Creek
West Side Canal
East Side Canal
U.S. 287
Crow Creek
Dry Creek
Missouri River
Greyson Creek
T.5N
T.6N
T.7N
T.8N
Townsend
US 12
White Sulphur Sps
Indian Creek
Cottonwood Creek
U.S. 287 Paved Road
Gravel Road
Canal
Reservoir
Ray Creek
East Side Canal
Canyon Ferry Lake
Kimber Creek
Gurnett Creek
Duck Creek
US 287
Helena
Winston

CATARACT

Introduction

This project consists of a dam and storage reservoir near Pony in Madison County, Montana. The reservoir, located on Cataract Creek, has a storage capacity of 1,478 acre feet. The project was financed with State funds and was completed in 1959.

Water Purchase Contracts

At present there are no water purchase contracts.

Water Rights

The Department filed for all unappropriated water on Cataract Creek and its tributaries on August 10, 1957.

Inspection Report

The seepage problem is so severe that water delivery is impossible. Lining, apparently the only solution, is not economically feasible at this time.

Engineering Data

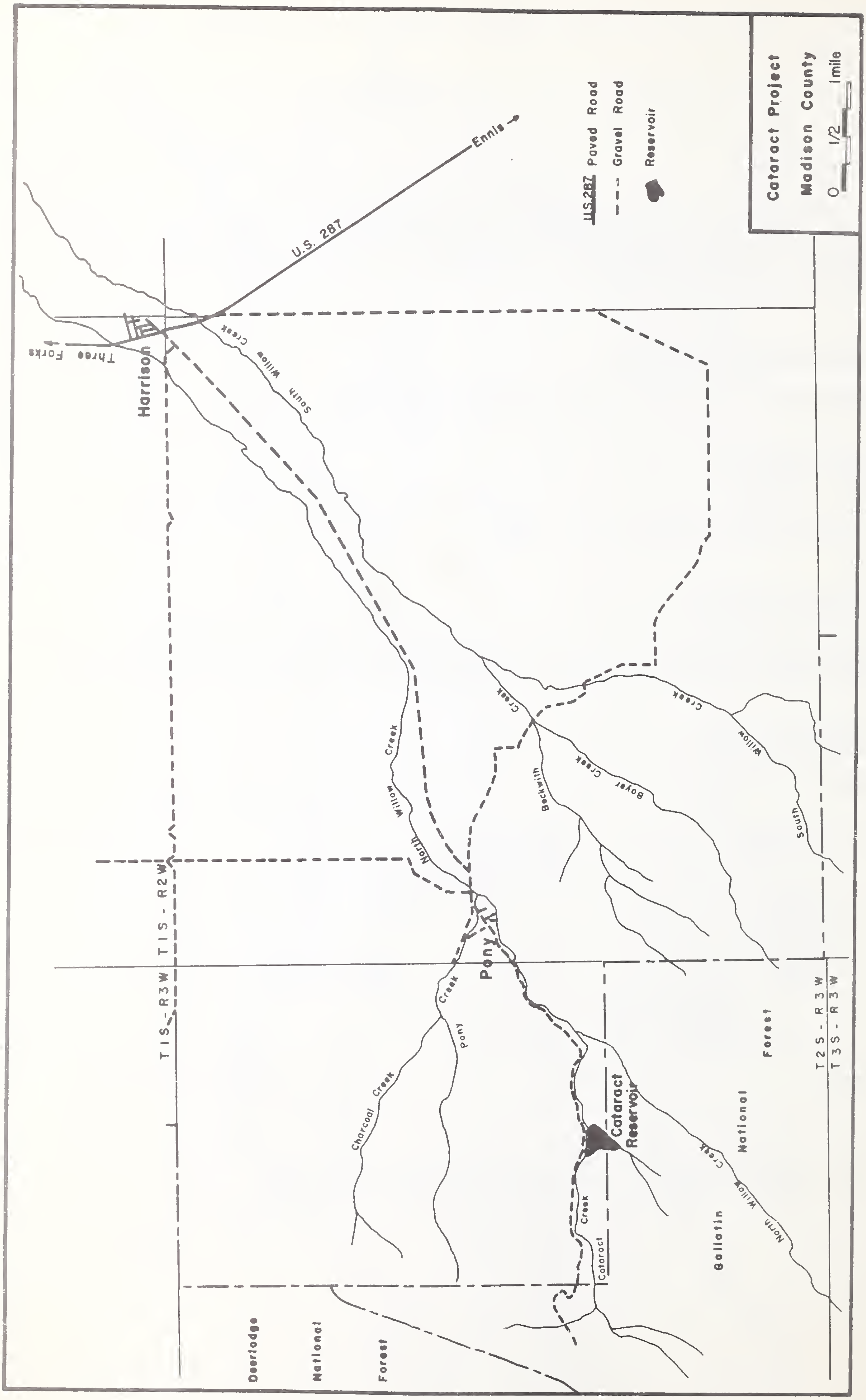
DAM:

Storage:	1,478
Spillway:	Width 20' Rock and Concrete Capacity 1,500 cfs
Gates:	2 - 30" dia. Slide -- Dry Tower
Height:	78'
Length:	775'
Type:	Earth Fill -- 120,600 cu.yds.
Content Measuring Device:	Cable Down Face
Initial Cost:	$196,958.25

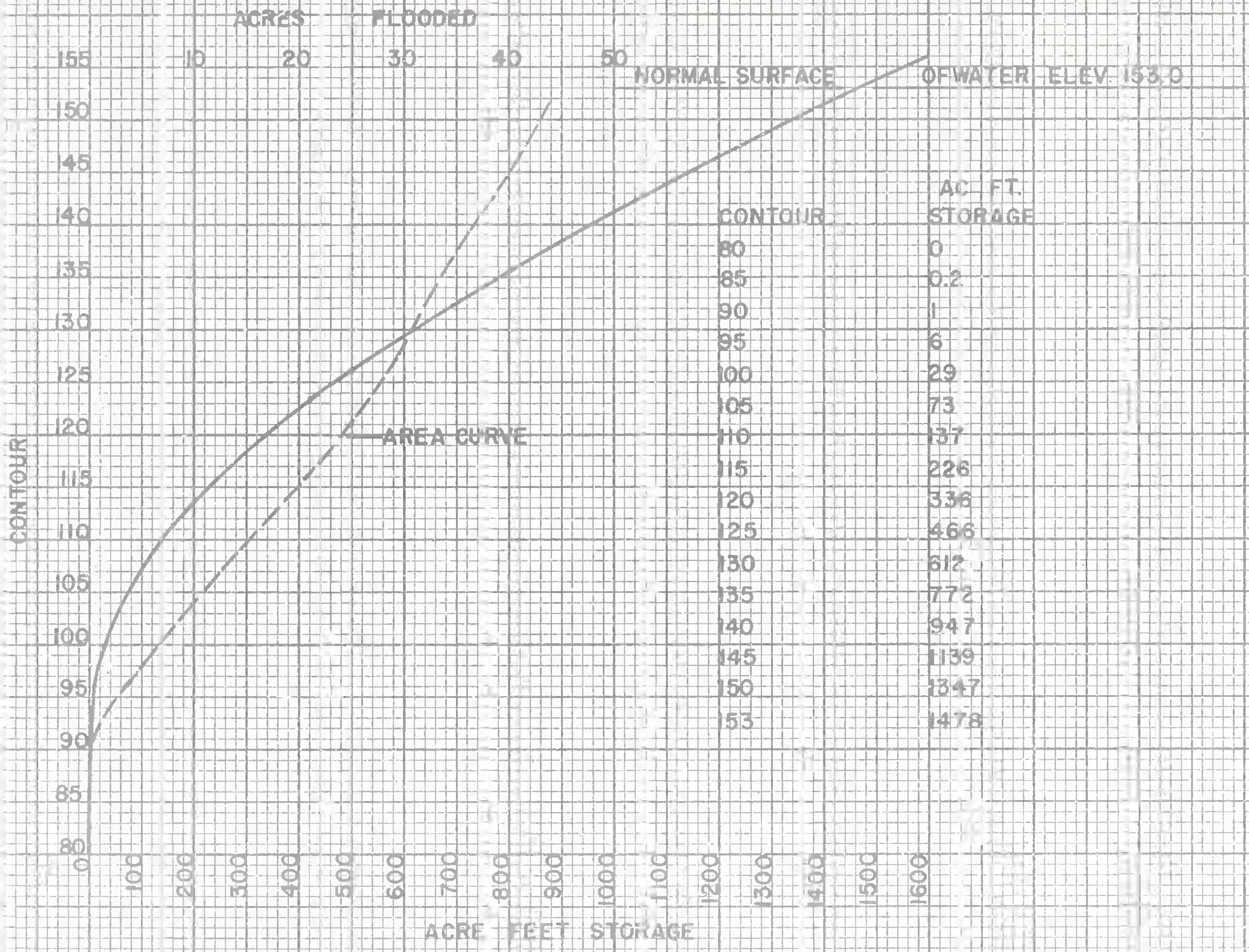
CANALS:

Private Diversion

R/W	Reservoir Pool:	45 Acres Deeded and Permit
	Reservoir Land:	7.8 Acres Deeded and Permit


Cataract Project
Madison County
0 1/2 1 mile
US 287 Paved Road
Gravel Road
Reservoir
U.S. 287
Ennis
Three Forks
Harrison
South Willow Creek
North Willow Creek
Creek
Beckwith
Boyer Creek
South Willow Creek
Pony
Pony Creek
Charcoal Creek
Cataract Reservoir
Cataract Creek
North Willow Creek
T1S - R2W
T1S - R3W
T2S - R3W
T3S - R3W
Deerlodge National Forest
Gallatin National Forest

CONTOUR	ACRES FLOODED
82.5	.04
87.5	.16
92.5	1.0
97.5	4.2
102.5	8.8
107.5	12.8
112.5	17.8
117.5	22.0
122.5	26.0
127.5	29.2
132.5	32.0
137.5	35.0
142.5	38.4
147.5	41.6
151.5	43.7



CONTOUR	AC. FT. STORAGE
80	0
85	0.2
90	1
95	6
100	29
105	73
110	137
115	226
120	336
125	466
130	612
135	772
140	947
145	1139
150	1347
153	1478

CATARACT CREEK RESERVOIR

STORAGE CURVE

MADISON COUNTY PROJECT NO 740

CHARLO WATER SUPPLY PROJECT

Introduction

This project, which furnishes a domestic water supply to the town of Charlo in Lake County, Montana, consists of 1.8 miles of 6" and 4" wood stave pipe, a 40,000 gallon tank, and a 6" well, which is 408 feet deep. Water is pumped with two 100 G.P.M. pumps. The project was financed through bonds sold to local banks and individuals, and construction was completed in 1948.

Water Purchase Contracts and Finances

There are eighty-two domestic contracts and nine commercial contracts. In addition, there are a number of users, including several churches, who do not sign contracts but are billed for their water each month. The book charge and current bond balance on the project total $2,332.83. The Charlo Water Users' Association will pay this amount to the Department, and when the total indebtedness is repaid, the members will pay their contract amounts into an O & M fund.

Water Rights

The Department holds a groundwater right, which was filed on January 1, 1948, for 93 G.P.M. on the well.

Measuring Devices

There are no measuring devices on the project. Each user pays for his water at a monthly rate which varies from user to user.

Repairs and Maintenance

A new 40,000 gallon tank was installed in 1965. Numerous minor repairs have been made on the project. There are several stretches of pipe which are partially rotted. The Association is contemplating replacement of some of the wooden pipe with plastic pipe.

COLUMBUS

Introduction

This project consists of a diversion canal on the Yellowstone River in Stillwater County, Montana. The Columbus Canal begins at the end of the privately owned canal known as the Merrill Ditch. The original construction, financed with a loan and grant form the Public Works Administration and State Water Conservation Board funds, was completed in 1938.

Water Purchase Contracts and Finances

There are currently contracts for 1,500 miners inches (MI), which is the capacity of the system. The charges per miners inch on this project, which have been the same for a number of years, are $1.56 principal and $2.05 for O & M, for a total charge of $3.61 per miners inch. The O & M expenses should now be reduced as a result of new construction in 1971. The principal charge will be increased but the O & M charge will remain the same to start a reserve fund.

The book charge as of June 30, 1972 was $25,749.88. There are water purchase contracts for the future sale of water in the amount of $3,609.84. Therefore, based on the present water purchase contracts, there will be a shortage of return on the State's investment in the amount of $22,140.04.

Economic Analysis

Prior to construction of the siphons in 1971, the Soil Conservation Service had prepared an economic analysis for the project and determined that the project, with the new construction, was economically beneficial. The economists assumed that the water users would have to pay the total cost amortized over fifty years at 5 1/8% interest. They considered only direct costs and benefits in the analysis. The benefit/cost ratio was 1.19 to 1.0.

Water Rights

A water right was filed by the State Water Conservation Board on the Yellowstone River and tributaries on September 1, 1937, for all unappropriated water.

Measuring Devices

There are no measuring devices on this project, and the water users rely on the ditch rider's judgement for proper water distribution.

Inspection Report

Recent inspections have found the project to be very well maintained. The Columbus Water Users' Association inspect the project biannually and are conscientious about making any necessary repairs.

Recent Major Repairs

A persistent maintenance problem for this project has been the repair of two large flumes, and it is estimated that the cost of their repair averaged about $800.00 per year. Also, the Northern Pacific Railroad threatened, several times, to obtain an injunction because the leakage from one of the flumes was endangering their main line. In 1971 the flumes were replaced with concrete pipe siphons at a cost of $140,000.00, which was financed with a 50% grant through the Beartooth Resource Conservation & Development Program and a no-interest loan from the Montana Water Resources Board.

Other construction on this project has occurred as a result of the new interstate highway passing through the area. Part of the canal has been relocated and the Highway Department did concrete lining in sections of the canal.

Engineering Data

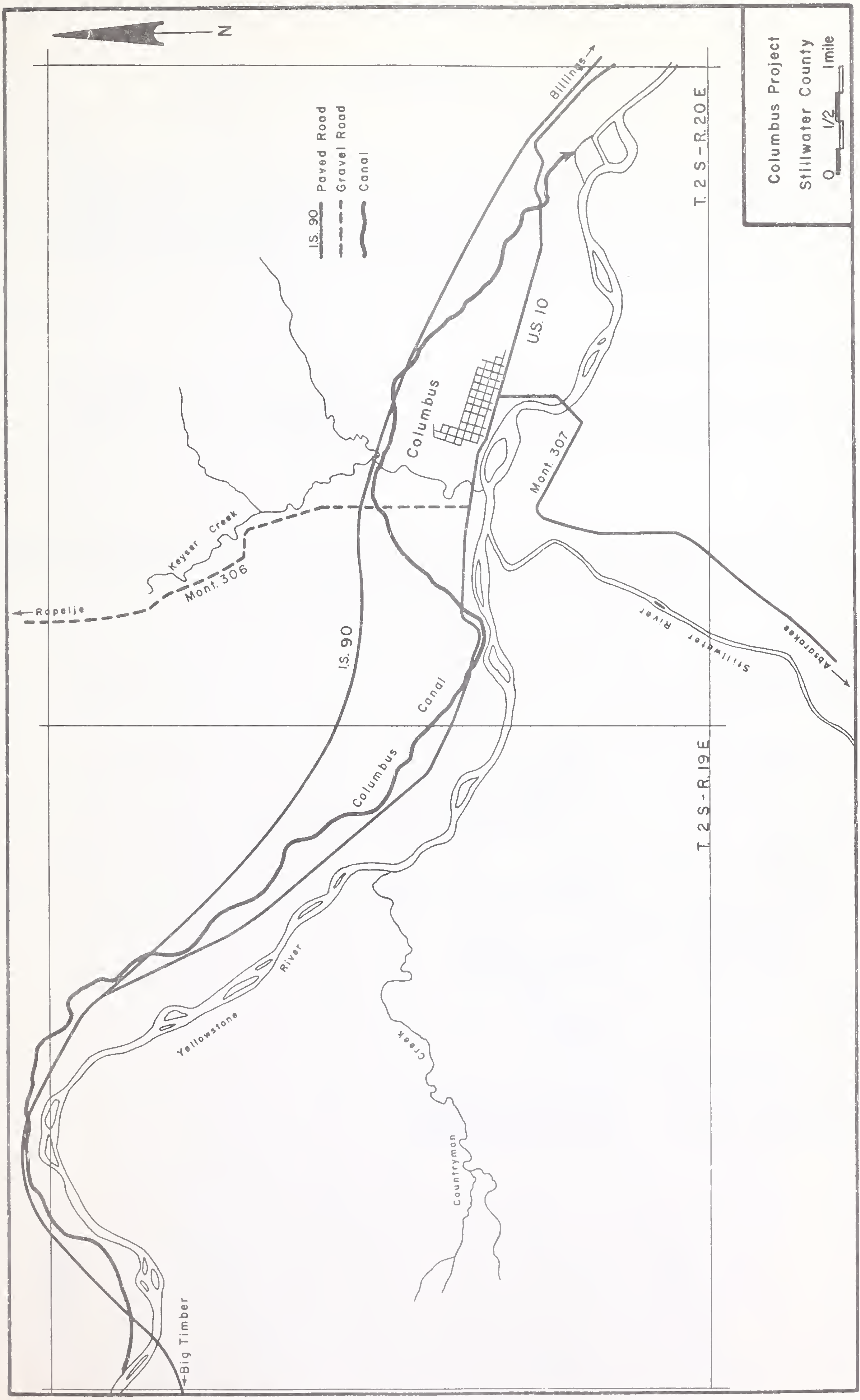
DIVERSION:

Storage: Direct Diversion
Gates: 2 - 48" x 48" Slide
Measuring Device: None
Initital Cost: $134,352.29

CANAL:

15.4 Miles
Capacity 102 cfs

R/W Canal: 33.85 Acres Deeded Plus
R/W for Merrill Ditch


Columbus Project
Stillwater County
0 1/2 1mile
N
I.S. 90 Paved Road
Gravel Road
Canal
Billings
T. 2 S - R. 20 E
T. 2 S - R. 19 E
U.S. 10
Columbus
Mont. 307
Keyser Creek
Mont. 306
Rapelje
I.S. 90
Columbus Canal
Stillwater River
Absaroka
Yellowstone River
Countryman Creek
Big Timber

COTTONWOOD

Introduction

The Cottonwood Storage or Shields Canal Project, which is located near Wilsall in Park County, Montana, consists of a storage dam and private canals. Construction of the project was completed in 1953 and was financed with State Water Conservation Board funds. The Department has very little involvement with this project.

Water Purchase Contracts

The Cottonwood Water Users Association has a contract with the Department to pay back $13,079.00 per year until all State-invested funds are returned. Book charges at present amount to $49,857.55.

Water Rights

The State Water Conservation Board filed a right for all unappropriated waters from Cottonwood Creek and its tributaries on June 23, 1953.

Engineering Data

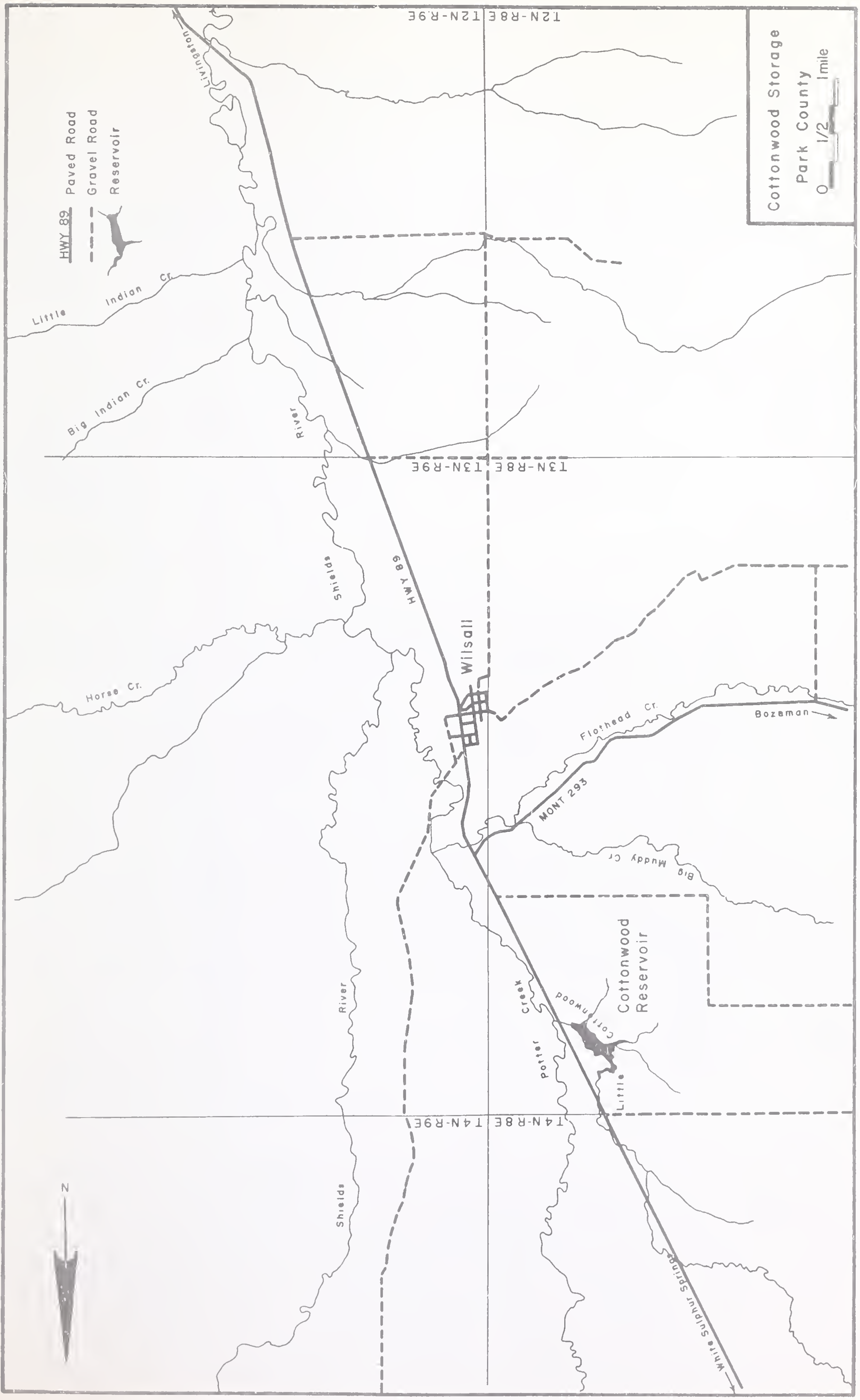
DAM:

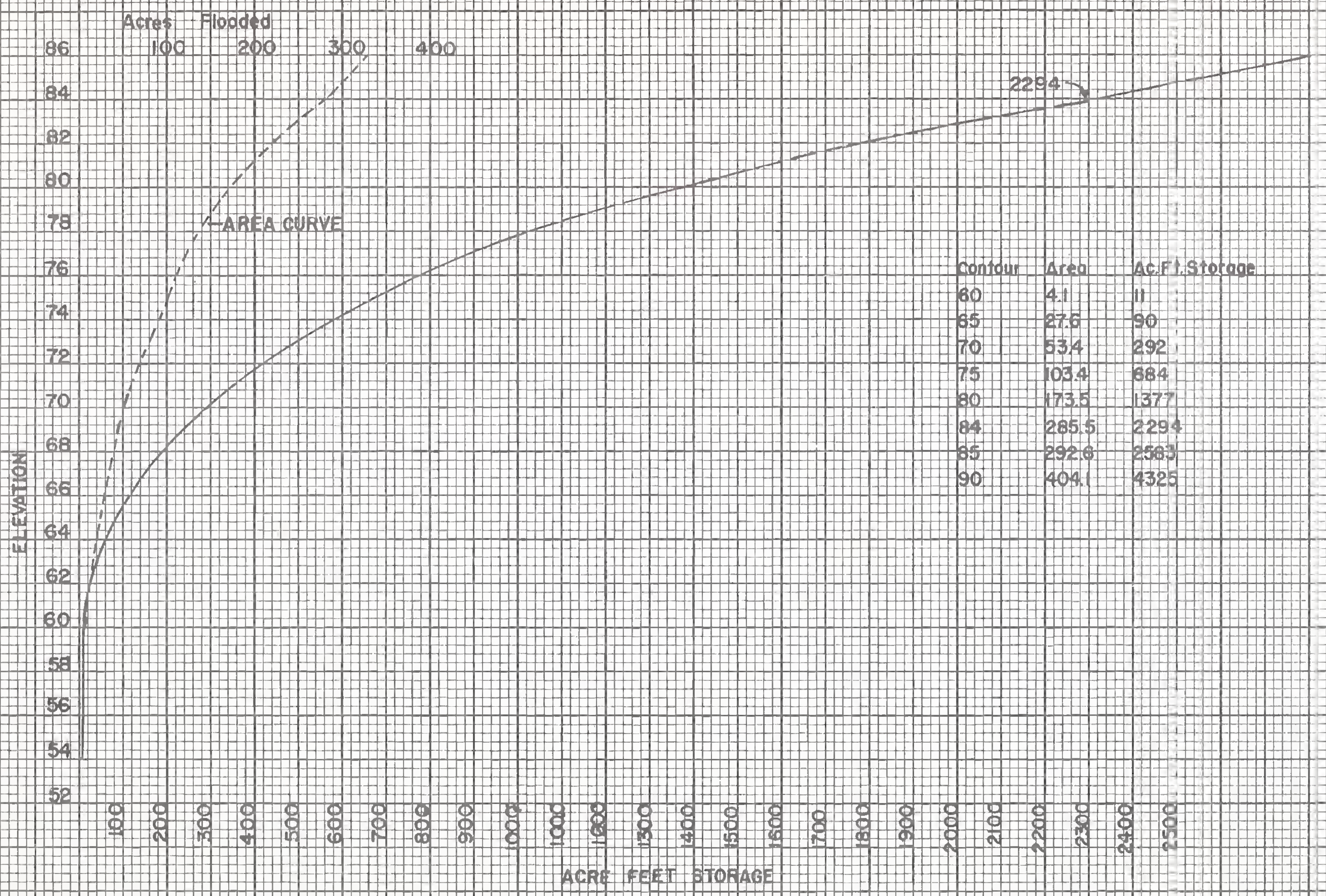
Storage: 1400 A.F.
Spillway: Width 20' Concrete
Capacity 1,150 cfs
Gates: 1 - 36" dia. Slide -- Wet Tower
Height: 37'
Length: 1,450'
Type: Earth Fill -- 41,680 cu. yds.
Content Measuring Device: Tape in tower
Initial Cost: $ 126,567.46

CANALS:

Private Diversion

R/W Reservoir Pool: 175 Acres Deeded
Reservoir Land: 299 Acres Deeded


Cottonwood Storage
Park County
0 1/2 1mile
HWY 89 Paved Road
Gravel Road
Reservoir
N
T2N-R8E T2N-R9E
T3N-R8E T3N-R9E
T4N-R8E T4N-R9E
Livingston
Little Indian Cr.
Big Indian Cr.
Shields River
HWY 89
Wilsall
Horse Cr.
Flathead Cr.
Bozeman
MONT 293
Big Muddy Cr
Cottonwood Reservoir
Cottonwood
Potter Creek
Little
Shields River
White Sulphur Springs



Contour	Area	Ac.Ft.Storage
60	4.1	11
65	27.6	90
70	53.4	292
75	103.4	684
80	173.5	1377
84	285.5	2294
85	292.6	2563
90	404.1	4325

COTTONWOOD RESERVOIR

STORAGE CURVE

PROJECT NO. 703 PARK COUNTY

DALY DITCHES

Introduction

This project consists of 110 miles of canals. The major canals are known as Republican Ditch, Hedge Ditch, Ward Ditch, Skalkaho Hi-Line Ditch and Gird Ditch. There are other smaller canals, distribution laterals and waste ditches. The project was acquired by the State Water Conservation Board on October 1, 1942, from the Ravalli Land and Irrigation Company, which could no longer guarantee a water supply for the land served. The Republican and Hedge Ditches divert water from the Bitterroot River, the Ward and Skalkaho Hi-Line Ditches divert water from Skalkaho Creek, and the Gird Creek Ditch diverts water from Gird Creek. The Republican Ditch was originally constructed by the Republican Ditch Company prior to the year 1895. The Hedge, Ward, Skalkaho Hi-Line, and Gird Creek Ditches were all constructed by the late Marcus Daly prior to 1901. The largest item of reconstruction on the project was construction of the Skalkaho siphon in 1953 to replace deteriorating flumes and unstable canal sections.

Water Purchase Contracts

Three hundred and sixty members of the Ravalli Water Users' Association hold 426 contracts for about 14,000 acres of land on the project and most users pay $5.26 per acre per year. There are special agreements and special rates for small users and prior right holders.

Book charges for the project amount to $296,438.02. At the present repayment rate, this amount will be repaid in full in 1991.

Water Rights

The Department holds decreed rights to water from the Bitterroot River totaling 11,600 MI or 290 cfs and six decreed rights from Gird Creek for 1,700 MI. Rights to the Skalkaho Creek total 9,541 MI or 238.5 cfs. There are also exchange rights on Skalkaho Creek for 3,161 MI. This water is used by the project in higher canals and exchanged for Bitterroot River water delivered through the Hedge and Republican Ditches.

Measuring Devices

Clausen's rules are used to measure water on this project.

Operation and Maintenance

Several major items of rehabilitation and repair are being considered. They include: (1) Replacement of the Republican, Hedge and Reeser-Thompson Diversion and Winters Flume. (2) Consolidation of structures in the Mid-Skalkaho area. (3) Repair of the Bitterroot - Hedge slough. (4) Various riprap repairs.

There are basically two structures at the Republican diversion, the main diversion and the west channel structure. Repair costs to these structures have risen greatly in the past several years. The west channel structure is to be replaced and the main structure, rapidly approaching a zero-year life expectancy, should also be replaced.

The Hedge diversion was severely damaged in the spring of 1972. Repair costs are quite expensive, and this structure will also have to be replaced. Apparently the most practical method is to remove the structure and replace it with a reinforced concrete structure. There is a possibility, however, that a combination of diversions and pumping stations may be more practical.

The Reeser-Thompson diversion has washed out and it would not be economically feasible to replace it. A proposal has been made to take water from another canal with a pipe drop. A design is in process.

The Mid-Skalkaho consolidation would consist of replacing three diversions that were washed out in spring of 1972. The most practical solution would be to divert water out of the Hedge Ditch rather than replace the three structures.

The Winters Flume was also washed out in spring of 1972. This is to be replaced with a contour ditch.

The Department is presently repairing and riprapping the Bitterroot-Hedge slough. The river had cut into the hill below the Hedge Canal, causing the toe of the slope to slough.

It is estimated that completion of all listed repairs along with replacement of all structures with less than a seven year expected life will necessitate an increase in water charges of $2.28 per acre. This figure is based on the assumption that the project will receive 50% cost sharing and include a loan at the rate of 4%. It will call for a forty-year contract.

In 1972, an inspection of all structures on the project was made. Each structure was rated as to its expected life. The rating is available in the Engineering Bureau Office.

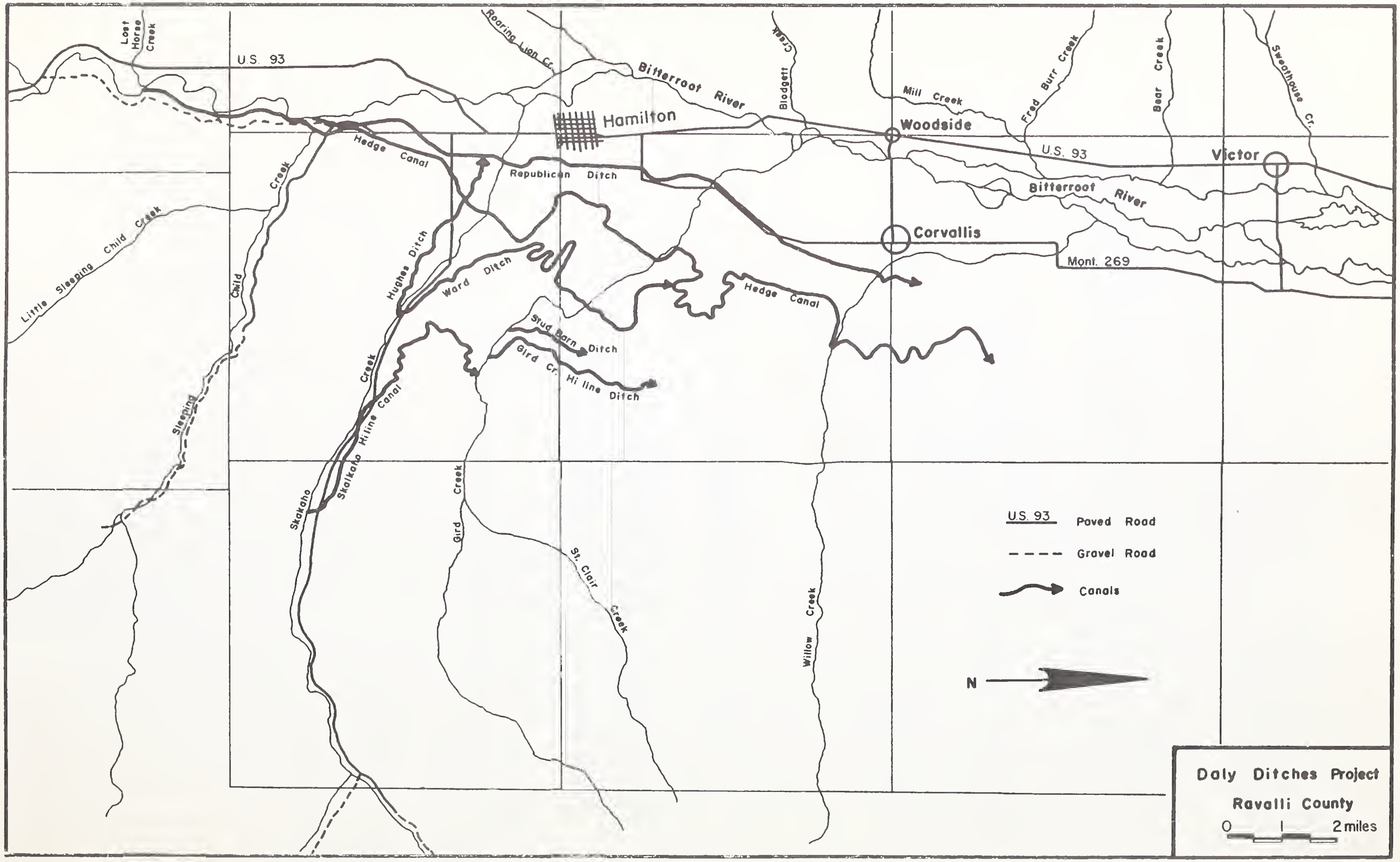
Engineering Data

DAM:

Storage: 120 A.F.
Spillway: Width 6'
Gates: 1 - 24" dia. Slide -- No tower
Height: 12'
Length: 650'
Type: Earth Fill
Content Measuring Device: None

CANALS:

Hedge:	23 miles Capacity 125 cfs Wood Diversion Dam and Concrete Headgate
Republican:	13 miles Capacity 150 cfs Wood Diversion Dam and Concrete Headgate
Ward:	8 miles Capacity 75 cfs Wood Diversion and Headgate
Skalkaho:	6 miles Capacity 50 cfs Concrete Diversion and Headgate
Gird Creek:	7 miles Capacity 20 cfs Wood Diversion and Headgate
Waste:	3 miles Capacity 50 cfs Wood Headgate
Rim:	3 miles Capacity 50 cfs Wood Headgate
Studbarn:	1 1/2 miles Wood Headgate
Rim:	2 miles Wood Headgate
Hughes:	4 miles Wood Headgate
Measuring Devices:	Water Storage Recorders on Hedge and Republican Others -- None
Initial Cost:	$517,778.77


Daly Ditches Project
Ravalli County
0 1 2 miles
U.S. 93 Paved Road
Gravel Road
Canals
N
Lost Horse Creek
U.S. 93
Roaring Lion Cr.
Bitterroot River
Hamilton
Blodgett Creek
Mill Creek
Woodside
Fred Burr Creek
Bear Creek
Sweathouse Cr.
Victor
U.S. 93
Hedge Canal
Republican Ditch
Bitterroot River
Corvallis
Mont. 269
Creek
Little Sleeping Child Creek
Child
Hughes Ditch
Ward Ditch
Hedge Canal
Stud Barn Ditch
Gird Cr. Hi line Ditch
Creek
Skalkaho Hiline Canal
Skalkaho
Sleeping
Gird Creek
St. Clair Creek
Willow Creek

DEADMAN'S BASIN

Introduction

The main feature of this project is a large off-stream storage reservoir known as Deadman's Basin, which has an estimated firm annual yield of 30,000 acre feet,a storage capacity of 76,900 acre feet, and a surface area, when full, of over 2,000 acres. Water is diverted from the Musselshell River through an 11.5 mile diversion canal with a capacity of 700 cfs. There are two outlet canals that return water to the Musselshell River. Most of the water used in this area is taken by private diversions from the Musselshell River,but the Lower Musselshell (Delphia-Melstone) Project relies on this project for most of its water supply.

The project was constructed through the joint efforts of the Water Conservation Board, the Counties of Golden Valley, Wheatland and Musselshell, and the Works Progress Administration. The project was mainly financed with a loan from the Reconstruction Finance Corporation, as well as State Water Conservation Board funds.

The project has a heavy recreational use. There are summer cabins on the lake shore, and the Fish and Game Department maintains picnic areas, campgrounds and boat launching sites. The flow of the Musselshell River is also stabilized by the project.

Water Purchase Contracts and Finances

There are currently contracts for 20,423 acre feet. The current charges for water are $.75 for principal and $.60 for O & M, making a total charge of $1.35 per acre foot. This O & M charge reflects a 20% increase in 1972 for the purpose of starting a reserve fund.

The book charge as of June 30, 1972, was $220,295.48. At that time there were water purchase contracts for future water sales in the amount of $213,659.00 and a repayment contract with an outstanding balance of $2,630.53. At that time there was a total unsecured debt of $4,005.95. Since that date, however, the users have signed a repayment contract for over $12,000.00, and there have been additional water sales. Therefore, based on current contracts, there will be an overrecovery on this project.

Water Rights

On May 10, 1934, the State Water Conservation Board filed for all unappropriated waters of the Musselshell River.

Measuring Devices

Continuous recorders have been installed in the inlet canal and both outlet canals, but there are no measuring devices,of record, at any of the individual turnouts. When water is needed, most water users simply open their gates. A project manager tries to release enough water from the reservoir to fill specific requests. However, most deliveries are through the Musselshell River, which is not an adjudicated stream.

Inspection Report

There have been several inspections of various parts of the project in the past three years, and a complete inspection is scheduled for spring of 1973. The recent inspections have found many areas in need of minor repair, such as additional riprapping, concrete patching, and bridge repair. The Deadman's Basin Water Users' Association has been remedying these problems as quickly as its finances permit.

Recent Major Construction

In 1960, a concrete drop was built on the Careless Creek Canal to replace a deteriorating wooden structure. A bridge was also constructed, and other repairs were performed. In 1962 and 1963, another drop on the Careless Creek Canal, known as the Franklin Drop, was rebuilt. In 1966, a new outlet structure for the conduit through the dam was built. In 1969, another drop structure on the Careless Creek Canal was rebuilt, and a combination bridge-drop structure was rebuilt on the Barber Canal.

Hinderences to Further Development of the Project and Proposed Project Improvements

One of the problems on this project is that there is no control over use of water from the Musselshell River, which is not an adjudicated stream, and another is the lack of measuring devices on its diversions. The latter seems to be an especially troublesome problem for the Delphia-Melstone Project, rendering it unable to sell additional water.

Still another problem is the poor water quality of the Musselshell River and its tributaries. Diverting the water through Deadman's Basin improved the water quality, but there is still a potential salt hazard in the river. The local county agent is now studying this problem.

Seepage areas below the dam and canals, especially Careless Creek Canal, are another problem. Water from Careless Creek Canal is also creating some erosion problems along the reach of Careless Creek between the Careless Creek Canal and the Musselshell River. A WICHE intern will study the seepage and erosion problems in the summer of 1973. Three alternatives he will consider are:

1. Lining the Careless Creek Canal.
2. Increasing the capacity of the Barber Canal so that all water can be routed therein.
3. Installing a new pipe drop from Deadman's Basin into the Musselshell River of sufficient capacity to take all of the water that is now routed through both canals or only the water that is now routed through the Careless Creek Canal.

Another study that is now underway is the Musselshell River Reservoir Operations Model, which should assist in the optimum operation of Deadman's Basin. It is being conducted by the Civil Engineering Dept. of Montana State University.

Engineering Data

DAM:

Storage: 76,900 A.F.
Spillway: Width 30'
Capacity 1,000 cfs
Gates: 2 - 60" x 60" Slide -- Wet Tower
Height: 63'
Length: 1,360'
Type: Earth Fill with 2,950' Dyke
Content Measuring Device: Tape in Tower
Initial Cost: $1,292,571.23

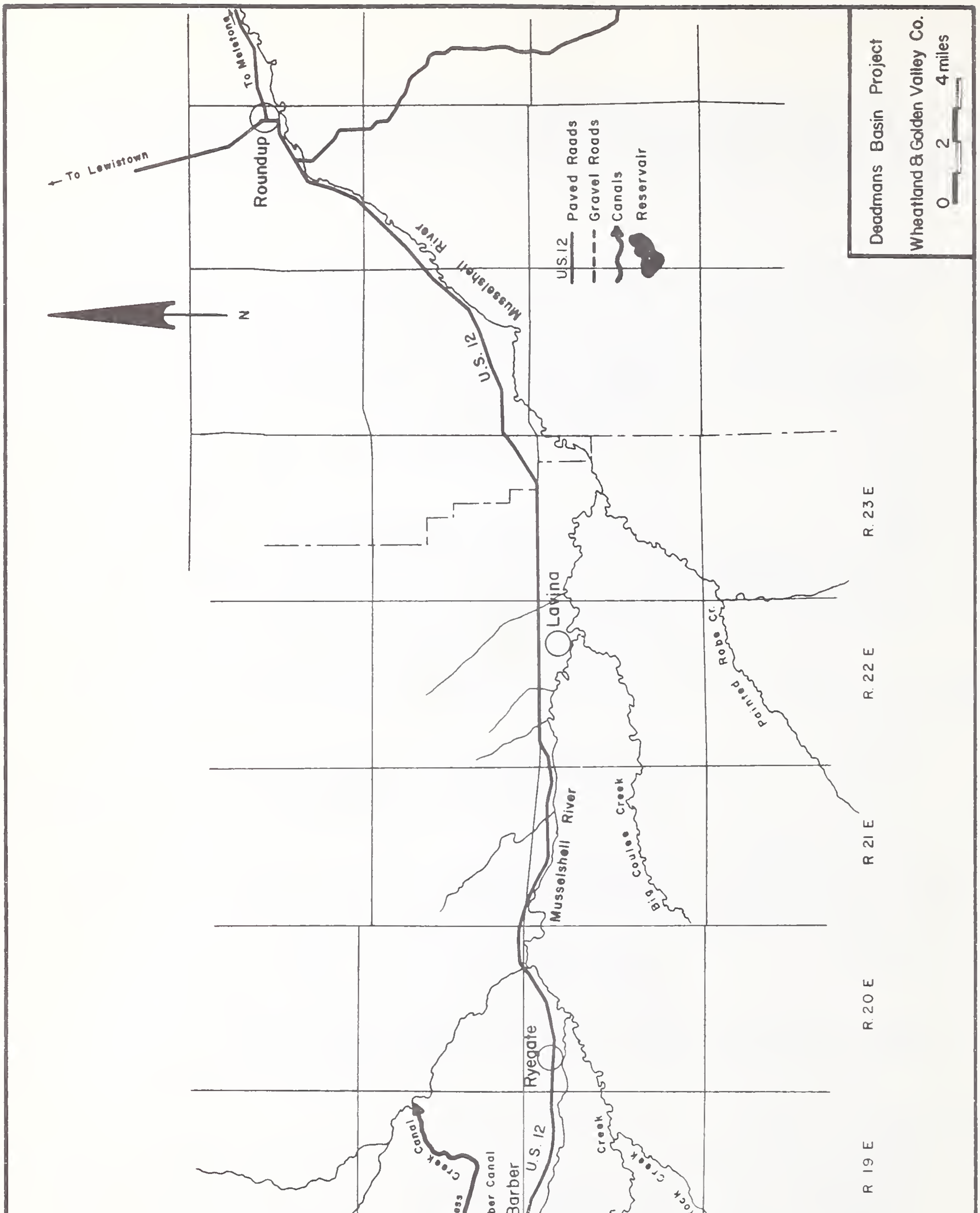
CANALS:

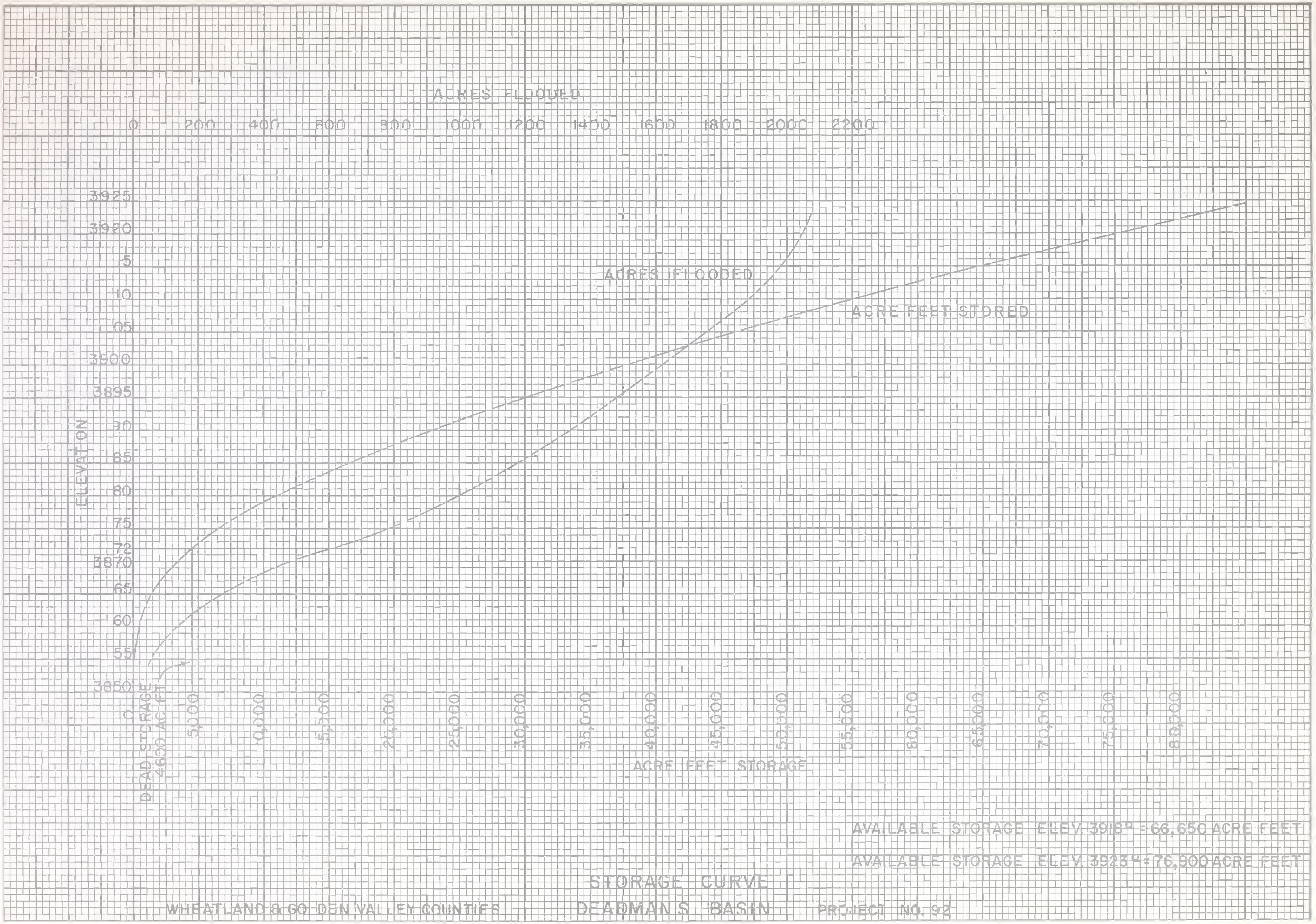
Supply: 11.49 miles
Capacity 600 cfs
Concrete Diversion and Headgate

Careless Creek: 9.50 miles
Capacity 344 cfs
Concrete Headgate

Barber: 2.85 miles
Capacity 200 cfs
Concrete Headgate (5' x 14' Radial)
Measuring Device: Water Stage Recorder on all Canals.

R/W Reservoir Pool: 2,000 Acres Deeded
Reservoir Land: 175 Acres Deeded
Canals:
  Supply: 723.34 Acres Deeded
  Careless Creek: 134.40 Acres Deeded
  Barber: 70.84 Acres Deeded
  Wasteway 59.56 Acres Deeded


Deadmans Basin Project
Wheatland & Golden Valley Co.
0 2 4 miles
U.S. 12 Paved Roads
Gravel Roads
Canals
Reservoir
N
← To Lewistown
To Melstone
Roundup
Musselshell River
U.S. 12
Lavina
Musselshell River
Big Coulee Creek
Painted Robe Cr.
Ryegate
Barber
U.S. 12
Barber Canal
Careless Creek Canal
Deadmans Basin Reservoir
Careless Creek
Fish Creek
Rock Creek
Mud Creek
Simmons Creek
Shawmut
Deadmans Basin Supply Canal
← To Harlowton
T.8N
T.7N
T.6N
T.5N
R.17E
R.18E
R.19E
R.20E
R.21E
R.22E
R.23E



AVAILABLE STORAGE ELEV. 3918^{0} = 66,650 ACRE FEET

AVAILABLE STORAGE ELEV. 3923^{0} = 76,900 ACRE FEET

STORAGE CURVE

WHEATLAND & GOLDEN VALLEY COUNTIES DEADMAN'S BASIN PROJECT NO. 92

DELPHIA-MELSTONE

Introduction

The Delphia-Melstone canals, located near Melstone in Musselshell County, Montana, are direct diversion canals constructed to permit utilization of storage water from Deadman's Basin. The total length of the canals on the project is sixty-seven miles. Construction on the Melstone unit was completed in 1949, and construction of the Delphia unit was completed in 1955. The project was financed with State Water Conservation Board funds.

Water Purchase Contracts and Finances

Forty-four users hold seventy-six contracts for 4,087 acres on the project, and each user is allowed two acre feet of water per acre of land. Each user pays $2.00 per acre per year for principal and $3.00 per acre per year for O & M. There is also a special assessment of $.25 per acre making a total charge of $5.25 per acre annually. The Lower Musselshell Water Users Association has no reserve fund.

Book charges for the project as of June 30, 1972, totaled $1,127,813.61. Expected future revenue from water purchase contracts totals $178,085.25, and there is an outstanding balance of $3,500.00 on repayment contracts. This leaves a total shortage of 946,228.36 under the state investment. More water could be sold on the project, but there are major maintenance and water supply problems.

Water Rights

On April 2, 1949, the State Water Convervation Board filed for 250 cubic feet per second from the Musselshell River.

Measuring Devices

There are no measuring devices on the project. Turnouts have concrete headwalls and metal screw slide gates.

Operation and Maintenance

In the past the users have had difficulty in keeping the project properly maintained. Parts of the canal have been cleaned occasionally. Recently, however, the users have made very good progress in their maintenance program. Several bridges have been repaired or replaced with culverts and a complete cleaning of the canal is in progress. They now seem to be able to keep up with their maintenance.

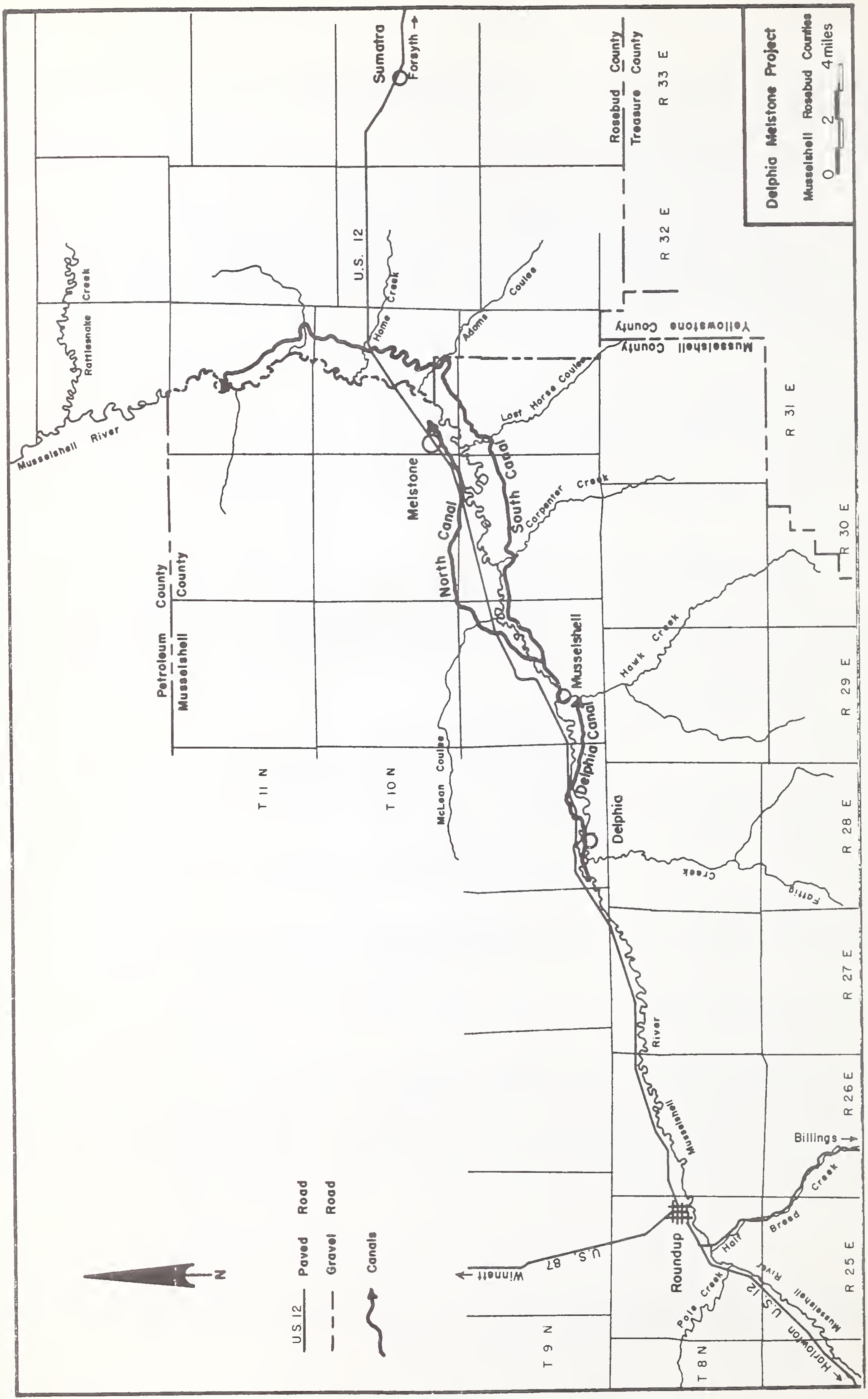
Hindrances to Further Development of the Project

One major problem is the lack of control over water use on the Musselshell River, which has not been adjudicated. There are no measuring devices on the diversions from the river. The local county agent is studying the poor water quality of the river and its tributaries. Still another problem on this project is the alkalinization of soils which is caused, in part, by the poor water quality of the Musselshell River. Concrete lining of the ditch has been mentioned as a possible partial solution.

Another study that is now underway is the Musselshell River Reservoir operations model. Conducted by the Civil Engineering Department of Montana State University, the study should assist in the optimum operation of projects on the Musselshell River. In the summer of 1973, a WICHE intern will study the Deadman's Basin and Delphia-Melstone projects in an effort to solve some of the problems.

Engineering Data

STORAGE:	Direct Diversion
CANALS:	
Delphia Canal:	9.5 miles Capacity 40 cfs 4 Siphons under Musselshell River Concrete Diversion and Headgate
Supply for North and South Canal:	1.5 miles Capacity 220 cfs Concrete Diversion and Headgate 3 - 60" x 60" Slide Gates
North Canal:	15.0 miles Capacity 100 cfs Concrete Diversion and Wood Plank Headgate
South Canal:	33.4 miles Capacity 135 cfs Concrete Diversion and Wood Plank Headgate
Measuring Devices:	Water Stage Recorder on all Canals
Initial Cost:	$1,028,505.88


Delphia Melstone Project
Musselshell Rosebud Counties
0 2 4 miles
U.S.12 Paved Road
Gravel Road
Canals
N
Sumatra
Forsyth →
Rosebud County
Treasure County
R 33 E
R 32 E
R 31 E
R 30 E
R 29 E
R 28 E
R 27 E
R 26 E
R 25 E
Yellowstone County
Musselshell County
Petroleum County
Musselshell County
U.S. 12
Rattlesnake Creek
Musselshell River
Home Creek
Adams Coulee
Lost Horse Coulee
Melstone
North Canal
South Canal
Carpenter Creek
Musselshell
Hawk Creek
Delphia Canal
Delphia
Fattig Creek
McLean Coulee
T 11 N
T 10 N
T 9 N
T 8 N
Musselshell River
Billings →
Half Breed Creek
Roundup
U.S. 87
← Winnett
Pole Creek
U.S. 12
Musselshell River
Harlowton →

FLINT CREEK

Introduction

The Flint Creek Project, which is located southwest of Philipsburg in Granite County, Montana, includes the East Fork of Rock Creek dam and the Main, East Marshall, Allendale, and Metcalf canals. The reservoir has a capacity of 16,040 acre feet. The combined length of the canals is 46.6 miles. Construction, completed in 1938, was financed with a loan and grant from the Public Works Administration and with State Water Conservation Board funds.

Water Purchase Contracts and Finances

Forty members of the Flint Creek Water Users Association hold seventy-one contracts for 14,745 acre feet of water on the project. The users pay $1.00 per acre foot on a 29 year contract for construction charges and $1.25 per acre foot for O & M charges, making a total charge of $2.25 per acre foot. The reserve fund was depleted in a law suit and is presently being rebuilt.

Book charges for the project as of June 30, 1972, totaled $133,534.83. Expected revenue from water purchase contracts is $95,186.00. There is also a repayment contract with an outstanding balance of $1,155.00, leaving an overall shortage of $37,193.83 under the State investment.

Water Rights

On March 13, 1936, the State Water Conservation Board filed for all unappropriated and surplus waters on the following streams: (1) Cow Creek. (2) Flint Creek and tributaries. (3) Fred Burr Creek. (4) Haystack Gulch and tributaries. (5) Trout Creek and tributaries. (6) East Fork of Trout Creek and tributaries. (7) Middle, North, and South Forks of Willow Creek. (8) Ten unnamed coulees. (9) One unnamed canal. On October 22, 1935, a right was filed for all unappropriated and surplus waters of an unnamed creek. On June 12, 1944, a right was filed for 300 MI of Douglas Creek and for 600 MI of Flint Creek. The Department holds a decreed right, filed October 22, 1935, for all unappropriated and surplus waters in the East Fork of Rock Creek.

Measuring Devices

The Department maintains continuous water stage recorders on Main, Marshall, and Allendale Canals and on Trout Creek. The upper valley has thirty-seven turnouts with twenty-two meter gates, thirteen Parshall flumes, two weirs, and one pump with a meter. The lower valley has approximately thirty turnouts, all with meter gates, Parshall flumes, or submerged orifices.

Inspection Report

A September 13, 1972, inspection report includes the following notations:

1. There are stumps and other debris on the upstream face of the dam. Burning is not allowed at the site, and the water users are having difficulty in finding a method to dispose of this debris.

2. A considerable amount of cracking has taken place in the tunnel. There is also a two inch hole in the floor with cavitation underneath. More investigation will be required to determine the extent of damage and the repairs needed.
3. The jet sump pump is not working properly. More investigation will also be required on this item.
4. Some old ladders should be removed from the bottom of the well.
5. The stem casing of the butterfly valve is pitted. These pits should be filled with epoxy or welded.
6. There is a considerable amount of erosion on the left side of the spillway.
7. The outlets are spalling and cracking. Patching and riprap repairs are needed.
8. There is minor spalling at the canal diversion and at the stream check. (Patching and riprap repairs have been made.)

Operation and Maintenance

Seven thousand, seven hundred lineal feet of the main canal was lined with bentonite in the 1950's. Recently the Association was sued by an individual for damages to his property by seepage from the canal. An out-of-court settlement was made, which required the Association's entire reserve fund. There are no major repairs planned for the future.

Engineering Data

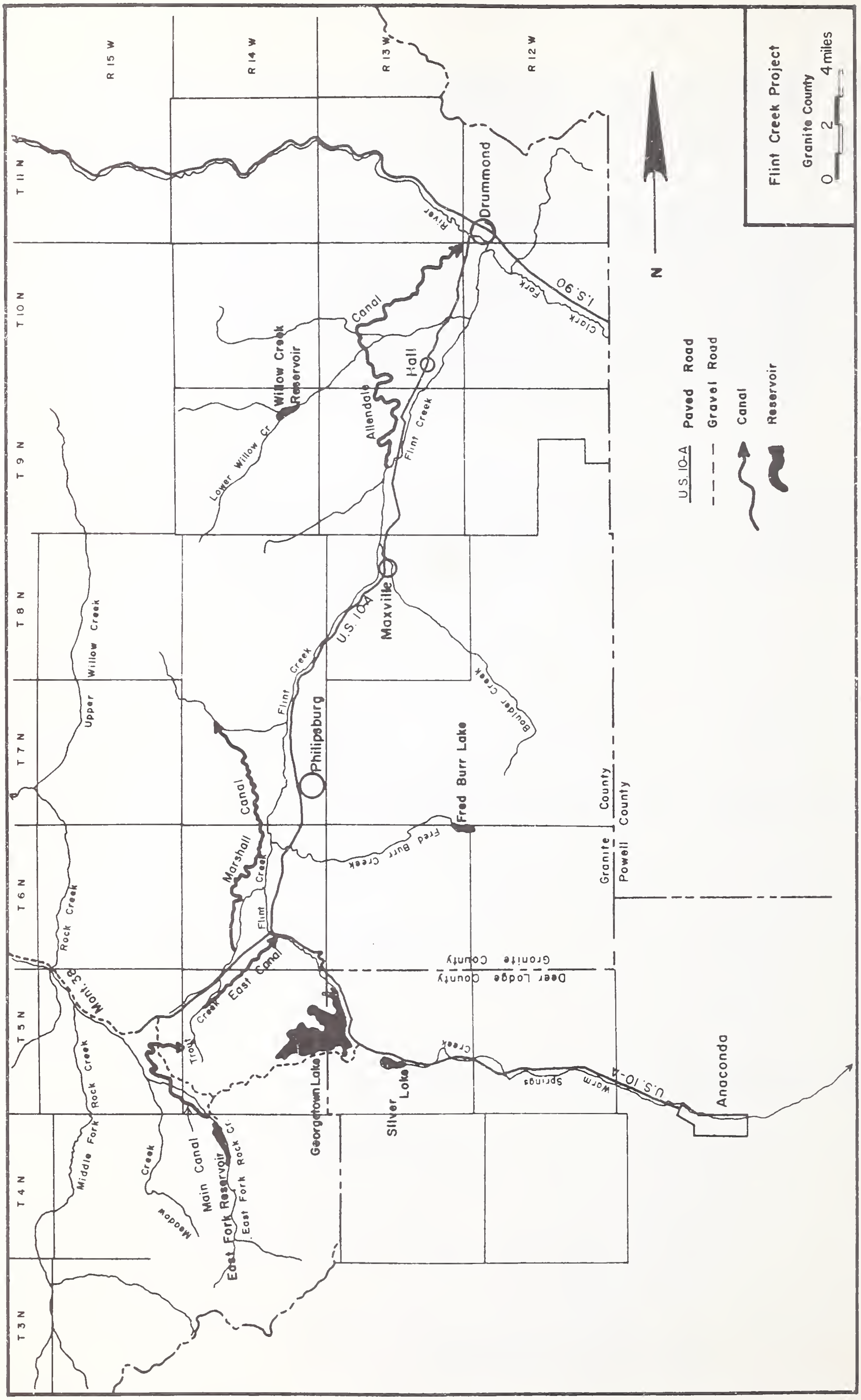
DAM:

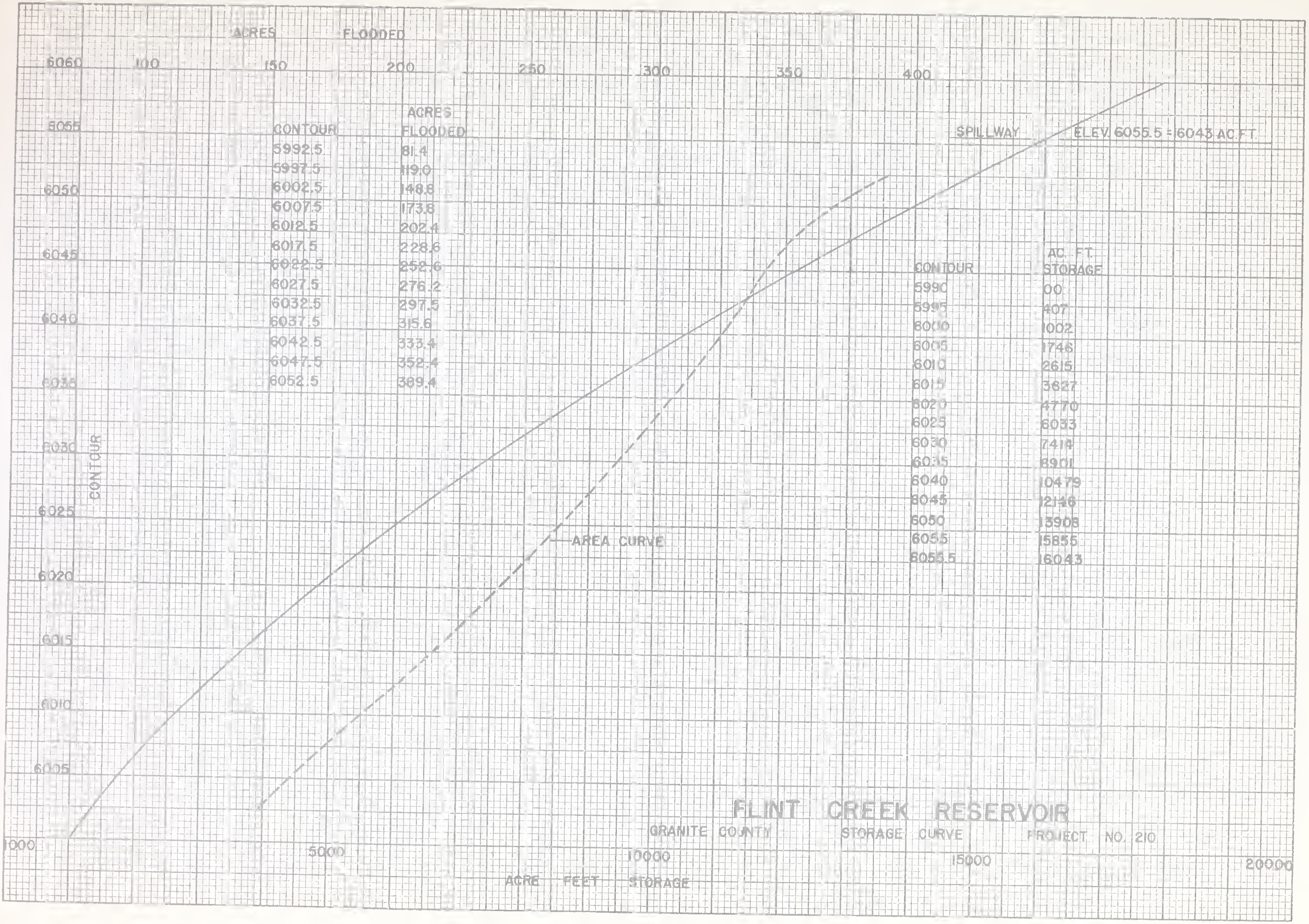
Storage:	16,040 A.F.
Spillway:	Width 50' Capacity 3,000 cfs
Gates:	1 - 54" diameter Slide and 1 - 54" diameter Pivot -- Dry Tower
Height:	87'
Length:	1,075'
Type:	Earth Fill -- 404,000 cu. yds.
Content Measuring Device:	Cable Down Face
Initial Cost:	$916,672.09

CANALS:

Main:	7.7 miles Capacity 200 cfs Concrete Headgate and 4050' of 54" steel Pipe Siphon
East:	5.81 miles Capacity 63 cfs Concrete Headgate
Marshall:	16.02 miles Capacity 56 cfs Concrete Headgate and Check
Allendale:	12.96 miles Capacity 125 cfs Concrete Headgate and Rock Diversion

Metcalf:	4.1 miles Capacity 17 cfs
Measuring Devices:	Water Stage Recorders on Main, Marshall, Allendale and Trout Creek.
R/W Reservoir Pool:	420.00 Acres Deeded and U.S.F.S. Permit
Reservoir Land:	489.11 Acres Deeded and U.S.F.S. Permit
Canals:	
Main:	82.3 Acres Deeded
East:	30.07 Acres Deeded Partially
Marshall:	98.0 Acres Deeded Partially
Allendale:	No Acreage Listed
Metcalf	15.01 Acres Deeded Partially


Flint Creek Project
Granite County
0 2 4 miles
U.S. 10-A Paved Road
Gravel Road
Canal
Reservoir
N
R 15 W
R 14 W
R 13 W
R 12 W
T 11 N
T 10 N
T 9 N
T 8 N
T 7 N
T 6 N
T 5 N
T 4 N
T 3 N
Drummond
Clark Fork River
I.S. 90
Canal
Willow Creek Reservoir
Lower Willow Cr
Allendale
Hall
Flint Creek
Maxville
U.S. 10A
Boulder Creek
Upper Willow Creek
Philipsburg
Fred Burr Lake
Fred Burr Creek
Granite County
Powell County
Marshall Canal
Flint Creek
Rock Creek
East Canal
Trout Creek
Mont. 38
Granite County
Deer Lodge County
Georgetown Lake
Silver Lake
Warm Springs Creek
U.S. 10-A
Anaconda
Rock Creek
Middle Fork
Meadow Creek
Main Canal
East Fork Reservoir
East Fork Rock Cr



CONTOUR	ACRES FLOODED
5992.5	81.4
5997.5	119.0
6002.5	148.8
6007.5	173.8
6012.5	202.4
6017.5	228.6
6022.5	252.6
6027.5	276.2
6032.5	297.5
6037.5	315.6
6042.5	333.4
6047.5	352.4
6052.5	389.4

CONTOUR	AC. FT. STORAGE
5990	00
5995	407
6000	1002
6005	1746
6010	2615
6015	3627
6020	4770
6025	6033
6030	7414
6035	8901
6040	10479
6045	12146
6050	13908
6055	15855
6055.5	16043

FLINT CREEK RESERVOIR

GRANITE COUNTY STORAGE CURVE PROJECT NO. 210

FRED BURR

Introduction

The Fred Burr project consists of a storage reservoir on Fred Burr Creek eight miles west of Victor in Ravalli County, Montana. The reservoir has a storage capacity of 515 acre feet and is located on Forest Service lands. An additional 300 acre feet per year is available from stream flow, and the area served by the project is 920 acres. Construction, which was completed in 1948, was financed with State Water Conservation Board funds along with loans totaling $7,000 from local individuals.

Water Purchase Contracts and Finance

At present seven users hold nine contracts for 515 acre feet of water. They pay $2.50 per acre foot for construction charges and are assessed O&M charges when expenses are incurred. Each contract is for fifty years.

Book charges for the project as of June 30, 1972, totaled $39,662.26. The total of water purchase contracts is $37,337.50, leaving a shortage of $2,324.76 under the initial State investment.

Water Rights

The Department holds a right decreed on June 1, 1870, for 60 MI from Fred Burr Creek. On May 25, 1946, the Department filed for all unappropriated water of Fred Burr Creek.

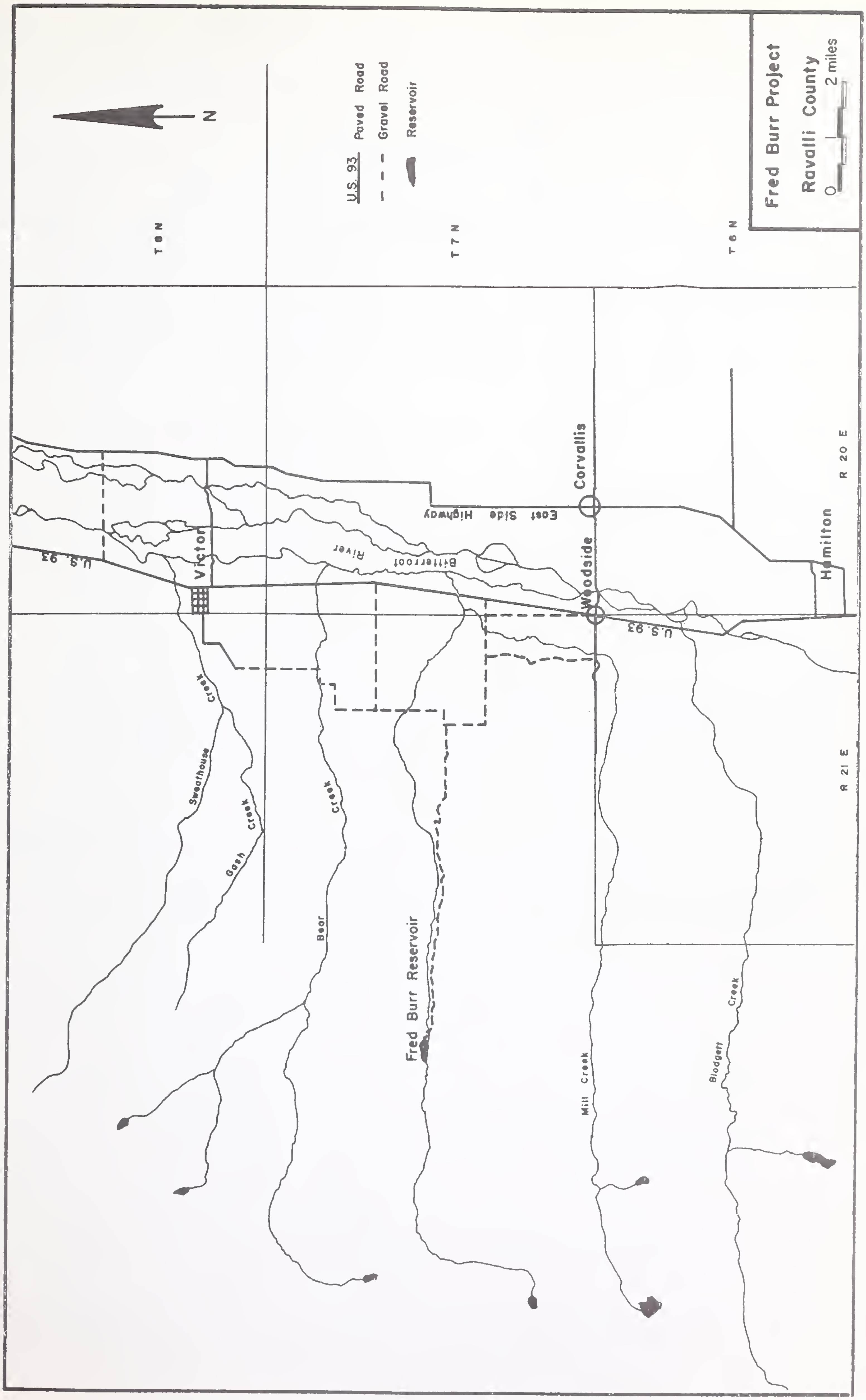
Engineering Data

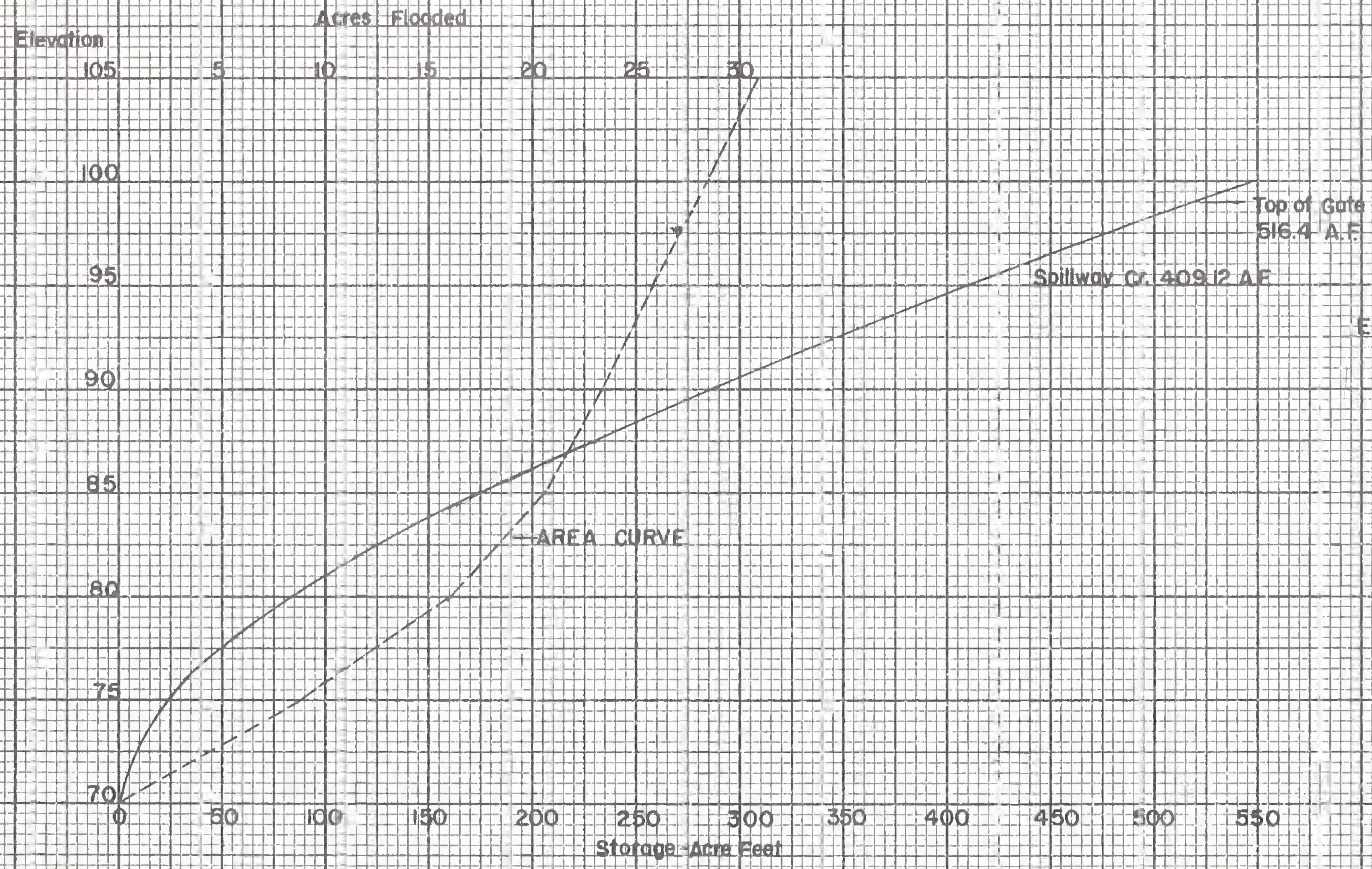
DAM:

Storage:	516 A.F.
Spillway:	Width 18' Capacity 1,400 cfs
Gates:	1 - 48" diameter Slide -- Wet Tower
Height:	50'
Length:	275'
Type:	Earth Fill -- 10,600 cu. yds.
Measuring Device:	Tape in Tower
Initial Cost:	$117,838.66

CANALS:
Private

R/W U.S.F.S. Special Permit -- Unsurveyed


Fred Burr Project
Ravalli County
0 1 2 miles
N
U.S. 93 Paved Road
Gravel Road
Reservoir
T 8 N
T 7 N
T 6 N
R 20 E
R 21 E
Victor
Corvallis
Woodside
Hamilton
East Side Highway
Bitterroot River
U.S. 93
U.S. 93
Sweathouse Creek
Gash Creek
Bear Creek
Fred Burr Reservoir
Mill Creek
Blodgett Creek



Elevation	Acres Flooded	Ac. Ft. Storage
70	0	0
75	8.80	22.00
80	16.14	84.35
85	20.55	176.02
90	23.44	286.07
95	25.79	409.12
100	28.56	544.97
105	30.94	693.72

FRED BURR CR. RES.
STORAGE CURVE
RAVALLI COUNTY PROJECT NO. 388

FRENCHMAN

Introduction

This project, consisting of a dam and reservoir with a capacity of 7,010 acre feet, is located about seventeen miles north of Saco in Phillips County, Montana. Canals and diversions on the project are privately owned. Construction of the project was financed from the State Water Conservation Board's revolving fund, except for a federal grant of Flood Disaster funds in the amount of $171,732.78 and was completed in 1950. Much of the project water is transported through a private canal owned by the Frenchman Canal Company.

Water Purchase Contracts and Finances

Nineteen users hold contracts for 6,450 acre feet on the project. The Frenchman Water Users' Association pays $.75 per acre foot per year on a 40-year contract for construction charges and $.25 per acre foot per year for O & M, for a total charge of $1.00 per acre foot. This project has an adequate reserve fund.

Water Rights

The Department filed an appropriation from Frenchman Creek dated July 25, 1950 for all unappropriated waters. The project also utilizes the water right of the Frenchman Canal Company for the first 4,440 MI in Frenchman Creek.

Measuring Devices

There are no measuring devices on the project. All diversions and canals are private.

Inspection Report

An October 10, 1972, inspection report includes the following:

1. Riprap is needed on the dam.
2. Sediment should be removed and riprap placed in the large slump area in the canal below the tunnel outlet.
3. Trees and brush should be removed from the spillway entrance.
4. Grass and tall weeds should be removed from the canal bottom.
5. Stem guides on gates require repair.
6. Minor cracking and spalling is occurring in the spillway floor joints, and the spillway floor has settled. The top of the right sidewall is spalled and there has been minor structural damage to the chute blocks and baffles.

The water users have been conscientious about making repairs in the past.

Proposed Project Improvements

At the 1972 Frenchman Water Users annual meeting raising the dam was discussed and an Association committee was formed to investigate possible sources of material and costs involved. There is considerable interest in additional water purchases.

Engineering Data

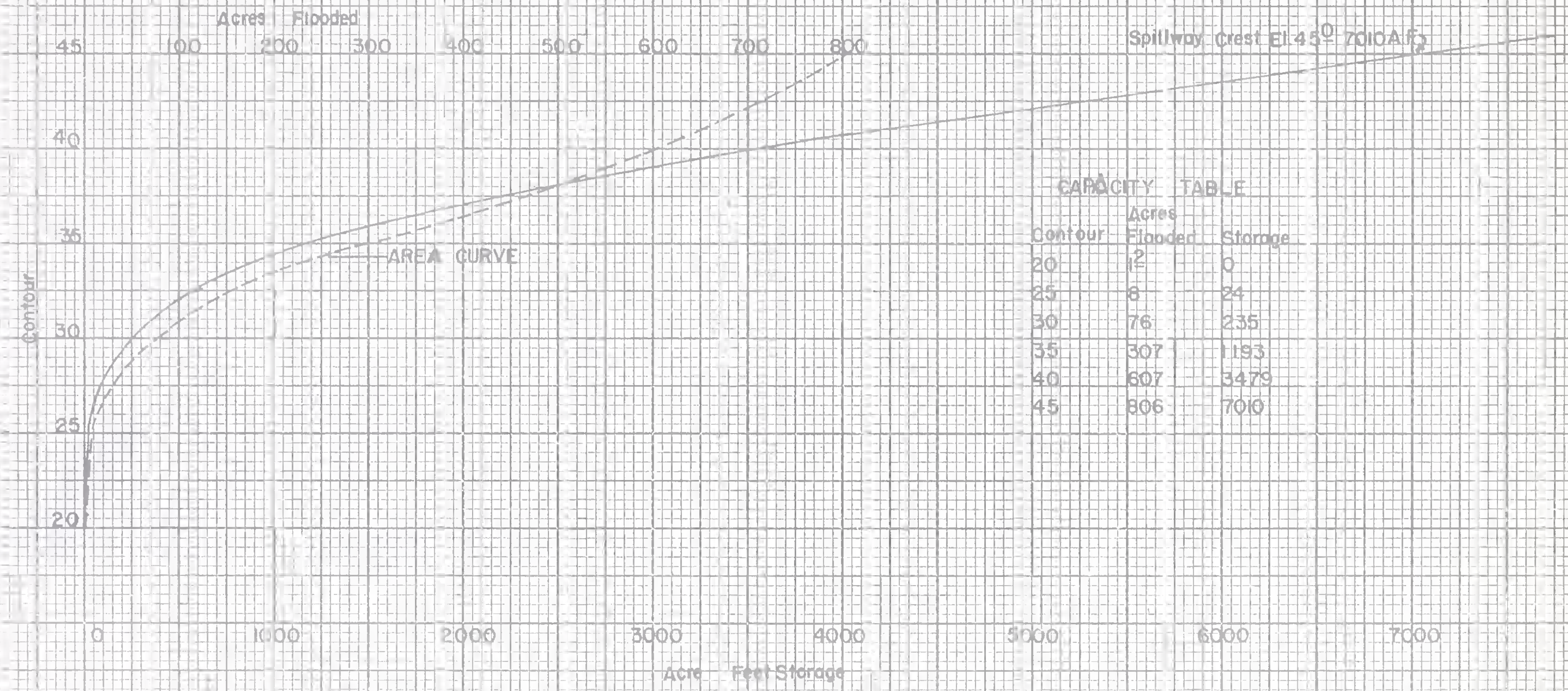
DAM:

Storage: 7,010 A.F.
Spillway: Width 125'
Capacity 12,000 cfs
Gates: 2 - 60" x 60" slide -- Wet Tower
Height: 41'
Length: 498'
Type: Earth Fill - 83,000 cu. yds.
Content Measuring Device: Tape in Tower
Initial Cost: $491,385.60

CANALS:

Private

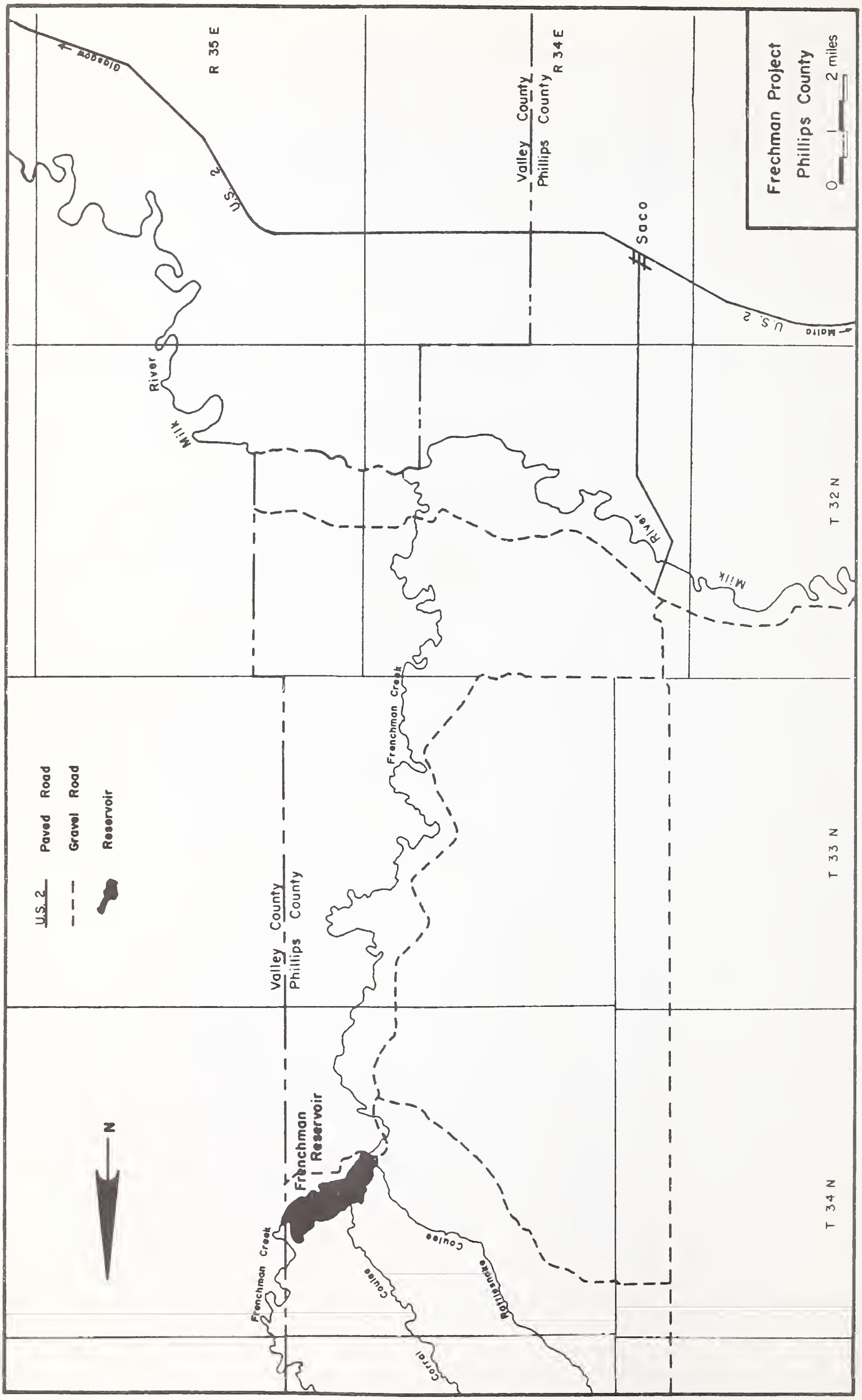
R/W Reservoir Pool: 806.0 Acres Deeded
Reservoir Land: 447.64 Acres Deeded



CAPACITY TABLE

Contour	Acres Flooded	Storage
20	12	0
25	8	24
30	76	235
35	307	1193
40	607	3479
45	806	7010

FRENCHMAN RESERVOIR
STORAGE CURVE
PHILLIPS COUNTY PROJECT NO. 714


Frechman Project
Phillips County
0
1
2 miles
U.S. 2
Paved Road
Gravel Road
Reservoir
N
R 35 E
R 34 E
T 32 N
T 33 N
T 34 N
Valley County
Phillips County
Saco
Glasgow
Malta
Milk River
Frenchman Creek
Frenchman Reservoir
Coulee
Rattlesnake Coulee
Corral Coulee

GREEN MOUNTAIN

This project consists of a diversion dam on Skunk Creek, a main canal 3.74 miles long with a 52 cfs capacity and 8 miles of laterals. It is located across the Clark Fork River from Trout Creek in Sanders County, Montana. The original construction work was completed on June 30, 1940. The project was financed with funds of both the Works Progress Administration and the State Water Conservation Board. This project, originally intended to be a part of the Swamp Creek project, was never completed.

Water Purchase Contracts and Finances

There are no water purchase contracts for the project.

Water Rights

The Department holds a water right for all unappropriated waters from Swamp Creek, dated May 18, 1939.

HYSHAM

Introduction

The main features of this project in Treasure County, Montana, are a pump from the Yellowstone River, two relift pumps, a canal system and related structures. The project, financed with State Water Conservation Board funds was completed in 1950.

Water Purchase Contracts and Finances

Currently there are contracts for 5,548 acres and the contracts allow for 2 1/2 acre feet of water per acre. The current charges are $1.75 for principal, $6.65 for Operation and Maintenance, and $.85 for special assessment for a total charge of $9.25 per acre each year. No reserve fund exists.

The book charge as of June 30, 1972 was $431,241.80. There are water purchase contracts for future water sales in the amount of $306,226.12 and a repayment contract with the Hysham Water Users Association, on which $31,381.28 is outstanding. This leaves a shortage, based on current contracts, of $93,634.40 less than the initial state investment. Apparently losses within the canal system are one of the main hindrances to additional sales.

Water Rights

A filing was made September 19, 1945 by the State Water Conservation Board for 200 cfs from the Yellowstone River and tributaries.

Measuring Devices

All water is measured through penvane boxes.

Recent Major Repairs

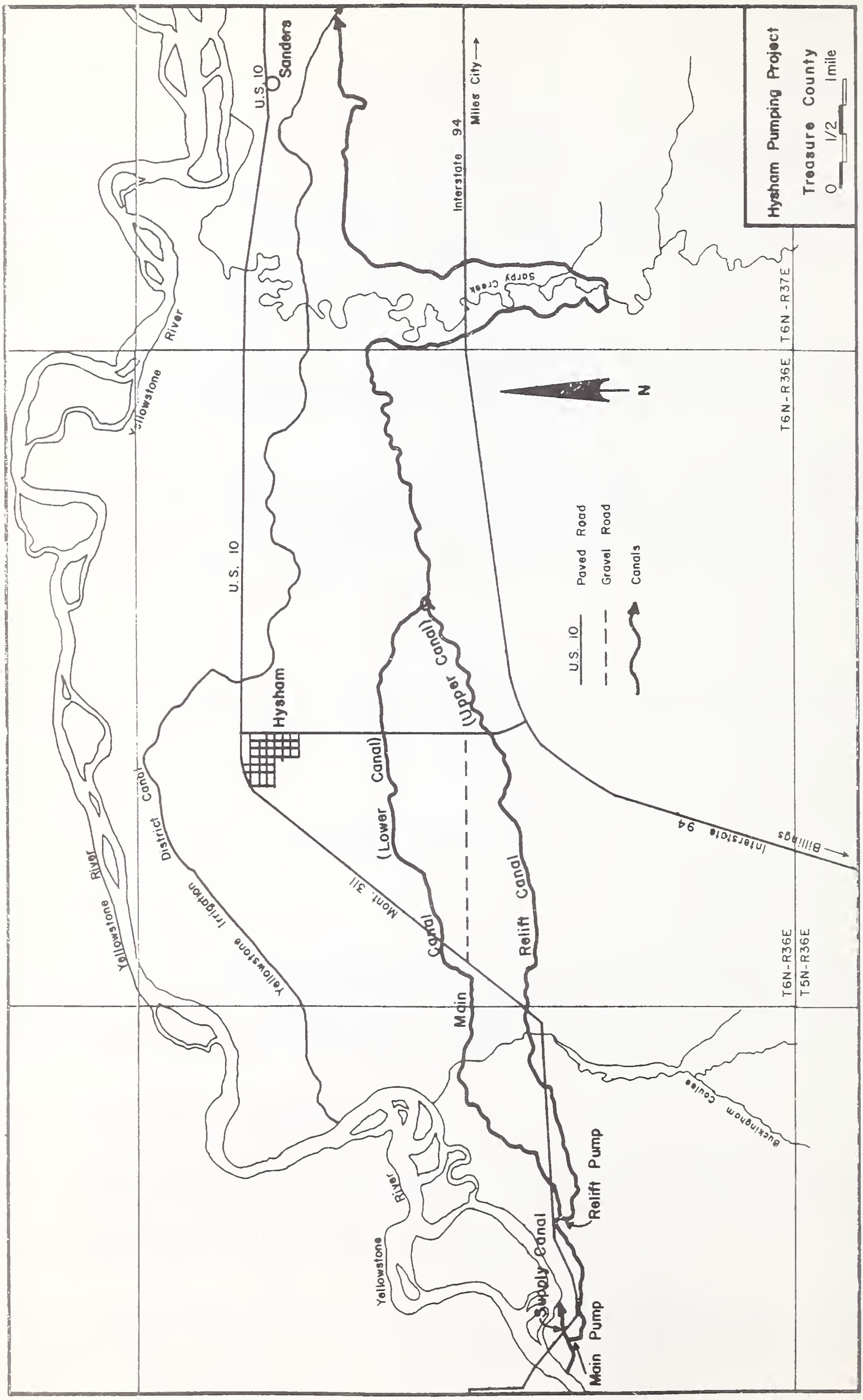
During recent years, there have been several major repairs to the pumps and motors, and these pose a continuing maintenance problem. In 1966 and 1967, parts of the canal were lined by the Association. The water users as individuals also lined parts of the canals from time to time. In 1972, a new relift pump was installed to supply additional water to the lower reaches of the upper canal.

Planned or Suggested Improvements

A major change affecting the project that will be made this year is the Burlington Northern Railroad's spurline up Sarpy Creek. If the present canal alignment is maintained, the railroad will cross the canal three times. An alternative that would eliminate two of these railway crossings but would involve a new crossing of Sarpy Creek by the canal is being considered.

An effort will be made in the next few years to sell additional water on this project. Some additional lining will be needed to reduce losses in the system, and larger pumps may have to be installed. Interest has been expressed in buying more water if it were available.

DIVERSION:	
Storage:	No Dam, Direct Diversion
Initial Cost:	$545,020.26
CANALS:	
Low Line:	19.3 miles Capacity 133 cfs 3 - 350 H.P. Pumps @ 19,500 g.p.m. Lift 56.02'
Hi Line:	8.34 miles Capacity 47 cfs 3 - 100 H.P. Pumps @ 6,750 g.p.m. Lift 45.11'
POWER LINES:	12.36 miles
R/W Low Line:	128.67+ Acres Deeded
Hi Line:	40.43+ Acres Deeded


Hysham Pumping Project
Treasure County
0 1/2 1mile
U.S. 10
Paved Road
Gravel Road
Canals
N
Sanders
U.S. 10
Interstate 94
Miles City
Sarpy Creek
T6N-R37E
T6N-R36E
Yellowstone River
Yellowstone River
Yellowstone River
Yellowstone Irrigation District Canal
Hysham
(Upper Canal)
(Lower Canal)
Main Canal
Relift Canal
Mont. 311
Interstate 94
Billings
T6N-R36E
T5N-R36E
Buckingham Coulee
Relift Pump
Supply Canal
Main Pump

LITTLE DRY

Introduction

The project, located in Garfield County, Montana, about thirty miles southeast of Jordan, consists of a reinforced concrete diversion and a twelve mile canal. The project is also known as Wasson Flats. Developed in the 1930's by the Water Conservation Board and the Works Progress Administration, it was completed in 1937 or 1938. The project operated fairly efficiently for several years. However, the earth diversion dam failed several times, and the ditch was finally abandoned in the early 1940's.

Water Purchase Contracts

The total cost for rehabilitation of the project was $144,832.58. Of this amount, $52,884.70 came from a Rural Environmental Assistance Program (REAP) grant. $40,000.00 was supplied by the Water Resources Board and is to be repaid. $50,000.00 was borrowed from the Farm Home Administration and will be repaid at 5% interest. The remaining $1,947.88 has been paid directly by the Little Dry Water Users' Association. No water purchase contracts have yet been executed, but agreements to contract for water have been signed.

Water Rights

The Department filed a 2,000 MI right on the Little Dry Creek on August 29, 1936.

Measuring Devices

Approximately nineteen Parshall flumes were installed on the project to measure water out of 16 turnouts installed.

Recent Major Construction

In 1972, a low-level reinforced concrete diversion dam was placed on Little Dry Creek. Approximately 61,200 lineal feet of existing canal was cleaned, reshaped and in some places rebuilt. The project will serve six ranchers and irrigate about 1,400 acres of land.

Engineering Data

DAM:

Concrete Diversion dam in the Little Dry Creek

Height:	14.4 feet, 4 feet Flashboards
Length:	124 feet

CANAL:

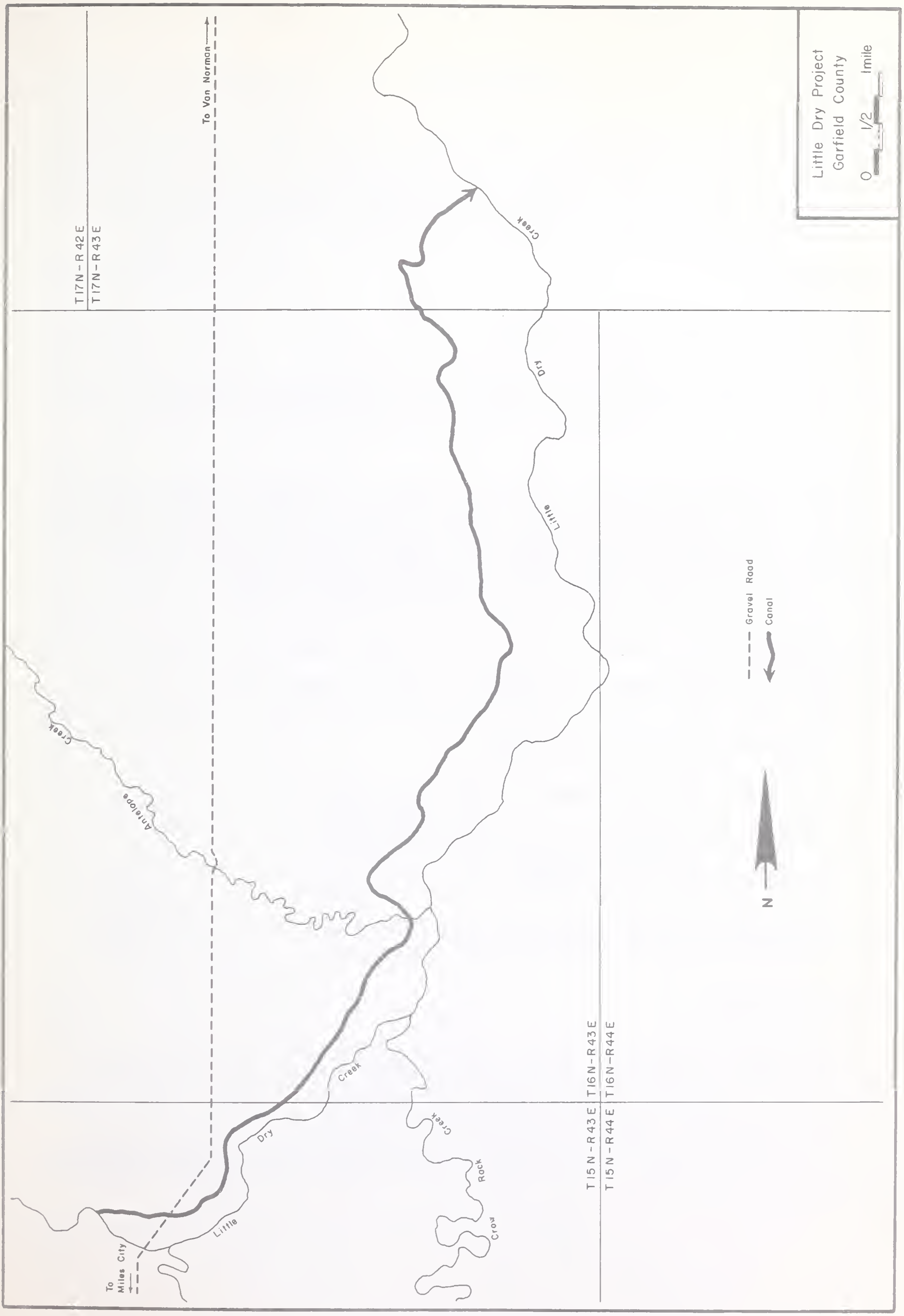
Type: earth
Length: 11.6 miles
Capacity: 90 cfs

Water is diverted from the Little Dry Creek during spring flows for water spreading practices.

Construction Charges:

Principal	$.92
Reserve fund	$.06
Contracts	Six
Users	Six

4248 Acre Feet Contracted


Little Dry Project
Garfield County
0 1/2 1mile
Gravel Road
Canal
N
To Van Norman
To Miles City
T17N-R42E
T17N-R43E
T16N-R43E
T16N-R44E
T15N-R43E
T15N-R44E
Little Dry Creek
Antelope Creek
Crow Rock Creek

LIVINGSTON DITCH

Introduction

This project in Park County, Montana, consists of a diversion dam in the Yellowstone River and a canal ten miles long with a capacity of 80 cubic feet per second. Construction was completed in 1937. The project was financed with a federal loan and grant and with State Water Conservation Board funds.

Water Purchase Contracts and Finances

There are currently contracts for 2,374 MI. The charges for the water are $1.00 for principal and $3.45 for O & M, making a total charge of $4.45 per MI annually. The Livingston Ditch Water Users Association has a small reserve fund.

The book charge as of June 30, 1972, was $4,280.09. There are water purchase contracts for future water sales in the amount of $2,463.00. Based on current contracts, there would be a shortage of $1,817.09 under the initial state investment. For several reasons additional water is not being sold, but the water users are now making an effort to correct these problems.

Water Rights

The Department holds several filed water rights to supply water for the lands irrigated under the Livingston Ditch. They are as follows:

1. 6,000 MI filed August 8, 1890.
2. 20,000 MI filed December 14, 1900.
3. 60,000 MI filed May 19, 1903.
4. 3,080 MI filed May 1, 1936.

All filings are on the Yellowstone River. (Some of the prior right holders were not required to make principal payments.)

Measuring Devices

The Department of Natural Resources and Conservation maintains a continuous recording device at the head of the canal. However, there are no measuring devices at the turnouts from the canal. The water users recognize the necessity for measuring devices and have decided on an installation program. Beginning with the largest water users, they will install as many devices each year as their funds will allow. Federal assistance for this project is being requested. The lack of measuring devices has been one of the major hindrances to further water sales.

Operation and Maintenance

In the past several years most of the bridges over the canal in Livingston have been repaired or replaced. Many of the bridges were replaced with culverts. In 1968, 100 feet of corrugated metal pipe was installed to replace a flume and repair some concrete and timber canal lining.

Future Repairs or Plans

The bridges across the canal and through the town of Livingston remain a major maintenance problem. The water users are repairing or replacing these bridges as rapidly as possible. Much of the canal through town is covered with planking. These planks can easily be removed by vandals, thus creating a safety hazard. Although the water users would prefer to replace the covered canal with a structure that would pose a lesser safety hazard, they do not feel they can afford it.

A problem of many water users is that their water, after leaving the main canal, must cross private lands before it reaches their lands. The association delivers water only from the main canal, and it is the responsibility of the individual water users to transport the water to their lands from the main canal. The ditch rider attempts to deliver the proper amount at each turnout, but he has no control over the water after it leaves the main canal. The ditch rider also seems to be somewhat uncertain regarding the amount of water to be delivered at each turnout. The problem of water delivery from the main canal can be resolved with measuring devices, but the individual water users must find some method to secure local cooperation for proper distribution to the individual turnouts.

Engineering Data

DAM:

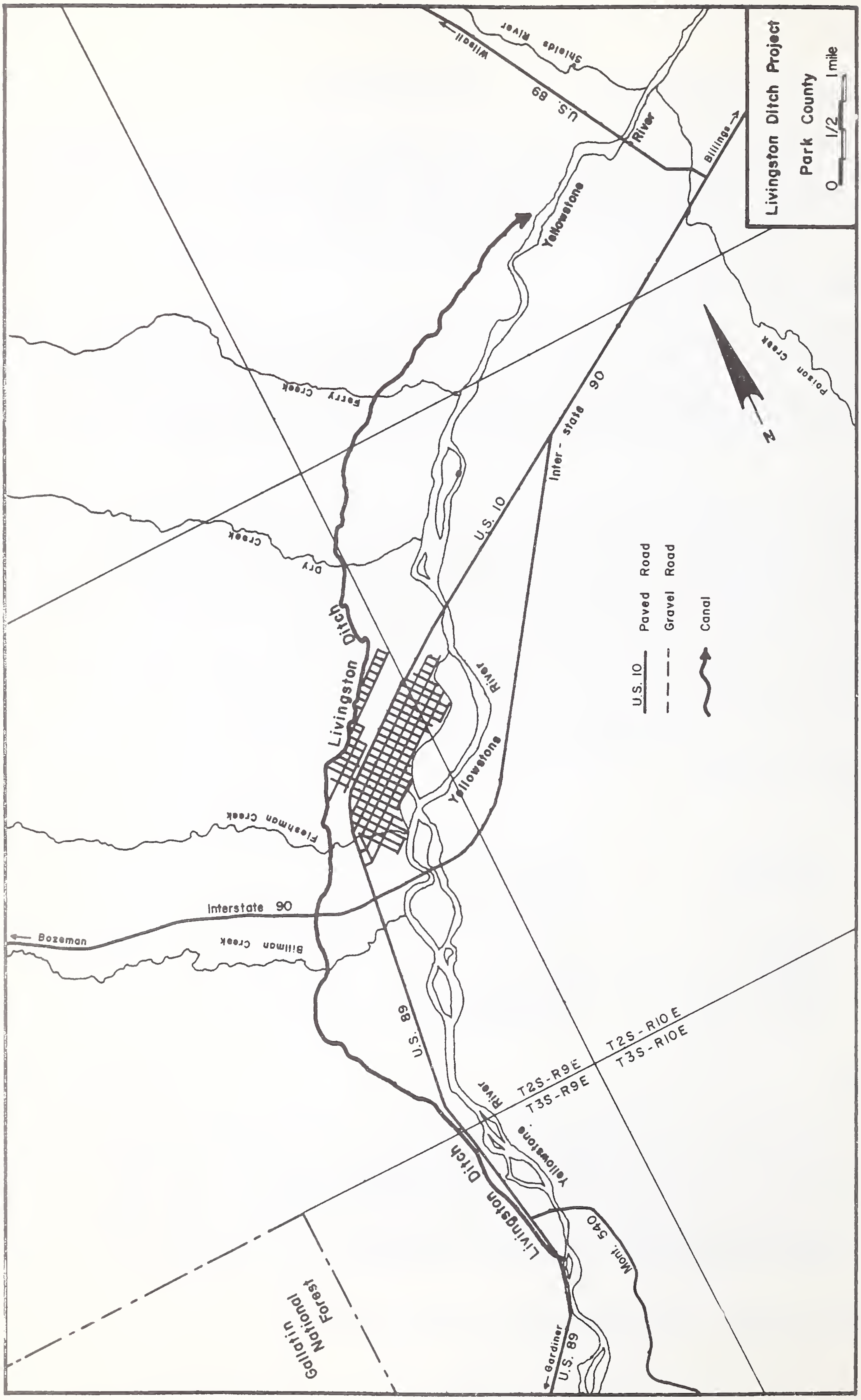
Storage: Direct Diversion
Spillway: Width 140'
Capacity Unknown
Gates: 2 - 42"x60" Slide Headgate
Height: 4.5'
Length: 140'
Type: Concrete
Initial Cost: $94,250.85

CANAL:

10.2 miles
Capacity 80 cfs
1,287 feet of Timber Lining
887.1 feet of C.M.P. Lining

Measuring Device: Water Stage Recorder

R/W No Deeds -- Took over Park Irrigation Company


Livingston Ditch Project
Park County

MIDDLE CREEK

Introduction

The Middle Creek Project consists of the Cottonwood Canal and Middle Creek Reservoir (also known as Hyalite Reservoir), which is located fifteen miles south of Bozeman on Hyalite Creek in Gallatin County, Montana. Cottonwood Canal has a length of 4.11 miles and a capacity of 77 cfs. The reservoir has a storage capacity of 8,027 acre feet. Construction of the project, which was started in 1939, was not completed until March 1, 1951. Financing was accomplished through a loan and grant from the federal government and State Water Conservation Board funds. The project supplies municipal water for the City of Bozeman, Montana State University, and supplemental water for 16,000 acres of land in the Gallatin Valley. Hyalite reservoir receives heavy recreational use.

Water Purchase Contracts and Finance

Seventy-four members of the Middle Creek Water Users Association, hold 105 contracts for 7,810 acre feet of water per year. The users pay $1.96 per acre foot on a thirty-year contract for construction charges and $.47 per acre foot for O&M charges, making a total charge of $2.43 per acre foot. A reserve fund has been established.

Book charges as of June 30, 1972, totaled $151,699.58. Expected future revenue from water purchase contracts is $152,461.05. The State will recover $761.47 over its investment.

Economic Analysis

A sensitivity analysis can be made to determine the probable range of the economic benefits which will result from the project. A detailed study was made in 1971, and two ranges of benefits were used in the report. The lower range assumes the project increased crop values on project lands by 10%. The upper range assumes a 50% increase. Recreational and municipal water users are also considered. Several different interest rates are used to bring the costs and benefits to current evaluation. The following table gives the results:

The Range of Benefit/Cost Ratios with Sensitivity Analysis, Based on an Ex-Post Analysis from 1951-1970, Middle Creek Project.

	i = 2%	i - 5%	i = 8%
LOWER ASSUMED BENEFITS	2.99	1.84	1.24
HIGHER ASSUMED BENEFITS	11.59	7.22	4.97

The preceding figures do not include secondary or extra-market costs or benefits, which include effects on general economic conditions, on the environment, and on community attitudes and stability. Among secondary benefits is the reduction in risk and uncertainty associated with crop production. Also, the project provides a municipal water supply for the city of Bozeman, which holds contracts for 2,510 acre feet per year and for Montana State University, which holds contracts for 450 acre feet per year. The reservoir is used extensively for fishing, boating and water skiing.

Water Rights

The State Water Conservation Board filed a water right for all unappropriated waters of Middle Creek (Hyalite Creek) on July 12, 1938.

Inspection Report

The dam was inspected on September 12, 1972. The report included the following notations:

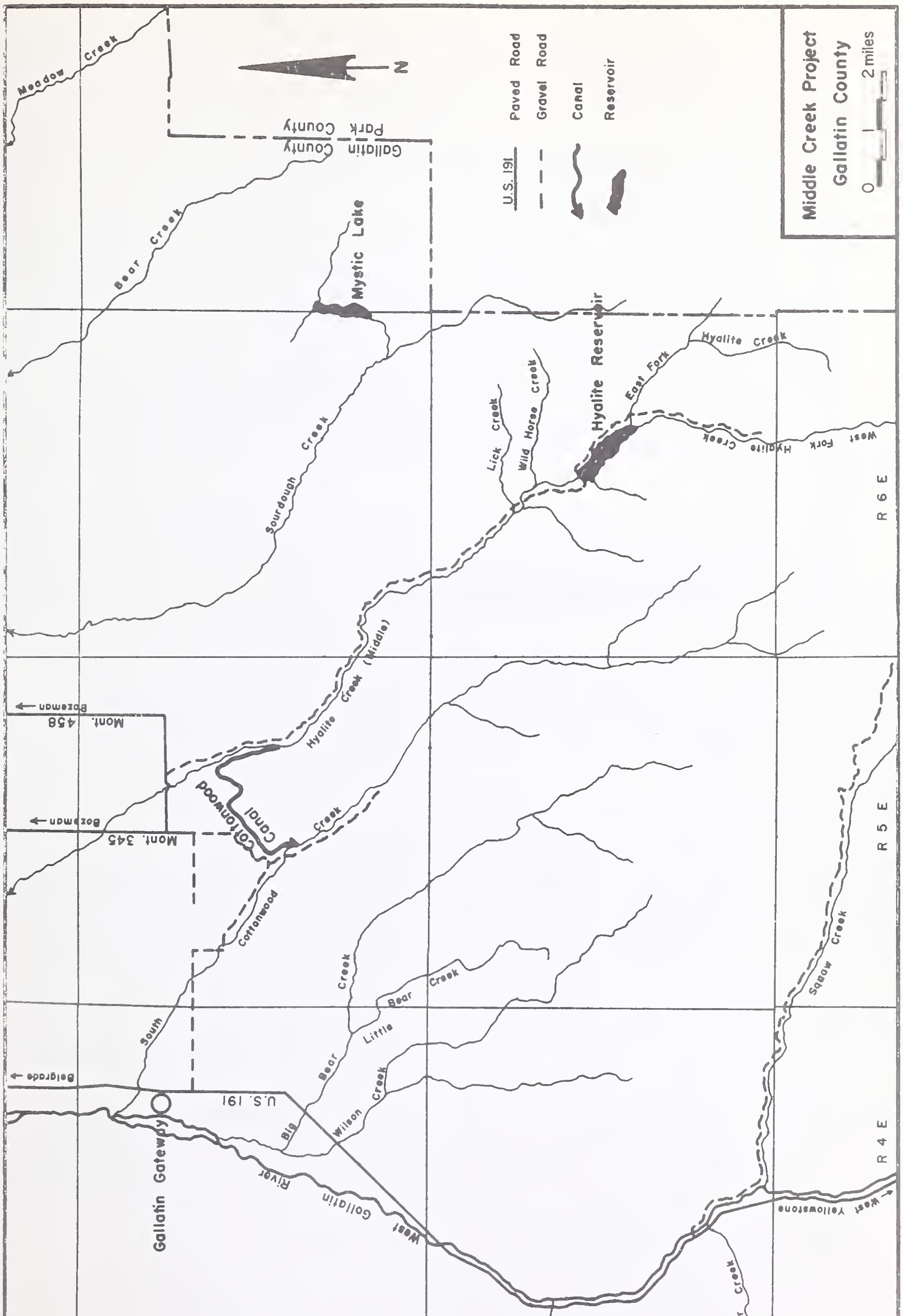
1. There are logs and stumps on the upstream face of the dam.
2. The tunnel has several minor cracks.
3. The tower ladder guardrail is missing.
4. The sump pump may not be operating.
5. The gate control stem guard is missing.
6. The emergency gate binds and should be operated semi-annually to keep it free.
7. The outlet is cracked and needs proper backfill.
8. Spillway concrete is badly spalled and deteriorating.
9. Chute blocks, baffles, and end sill are deteriorated.
10. One spillway wall has heaved due to saturated backfill. Drains have been installed to prevent further heaving of the spillway walls.

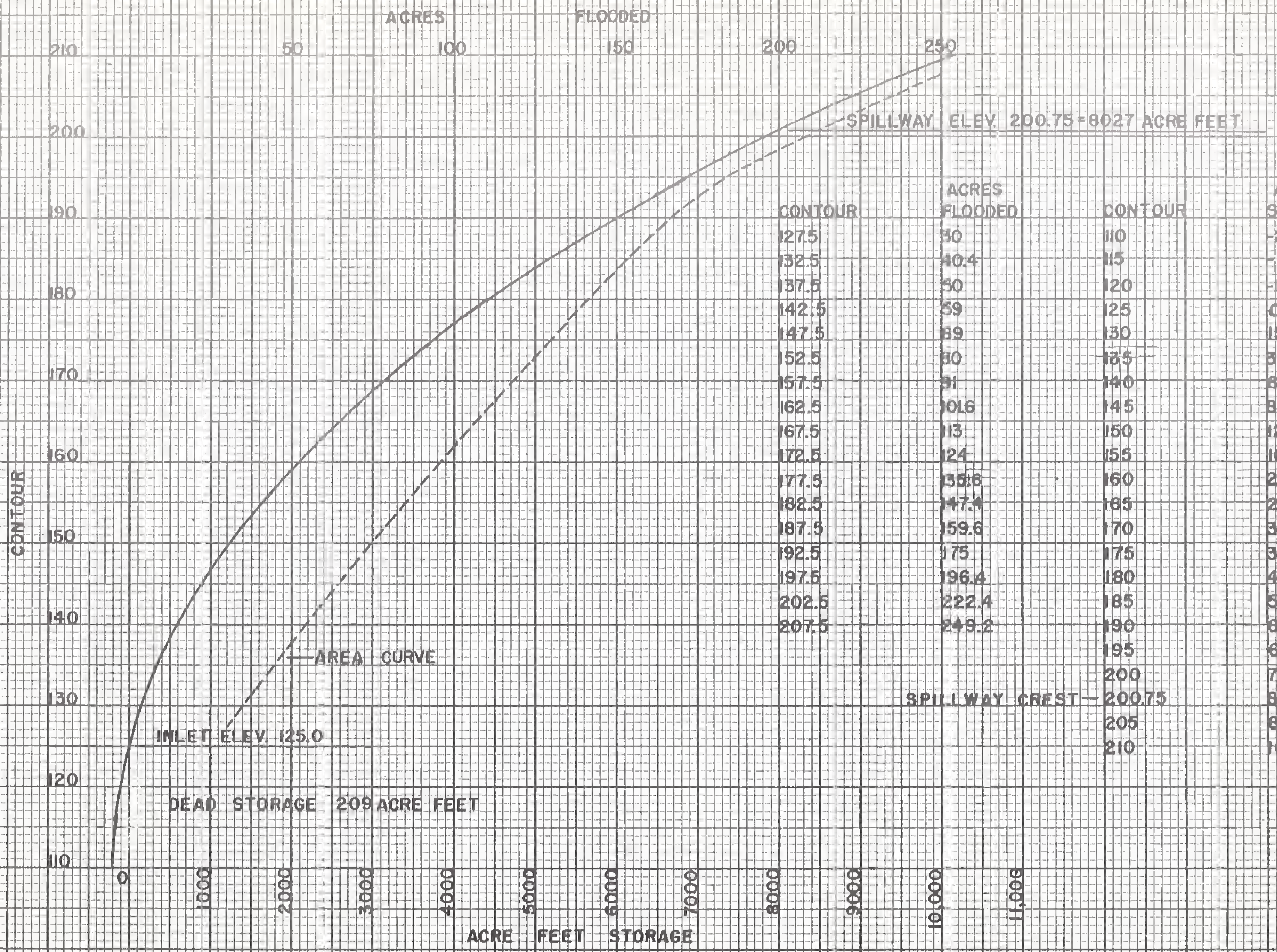
Operation and Maintenance

There have been very few maintenance problems since the project was built. However, the spillway concrete has deteriorated and may need to be replaced soon.

Engineering Data

DAM:	
Storage:	8,027 A.F.
Spillway:	Width 40' Capacity 3,000 cfs
Gates:	1 - 54" diameter Slide and 1 - 54" diameter Pivot -- Dry Tower
Height:	110'
Length:	1,310'
Type:	Earth Fill -- 569,500 cubic yards
Measuring Device:	Inside Pressure Tube
Cost:	$709,552.47
CANALS:	
Cottonwood:	4.11 miles Capacity 77 cfs 1,054 Feet of Metal Flume
R/W Reservoir Pool:	212 Acres Deeded and U.S.F.S. Permit
Reservoir Land:	54.22 Acres Deeded and U.S.F.S. Permit
Canal:	60.38 Acres Deeded and U.S.F.S. Permit


Middle Creek Project
Gallatin County
0 1 2 miles
U.S. 191 Paved Road
Gravel Road
Canal
Reservoir
N
Gallatin County
Park County
Meadow Creek
Bear Creek
Mystic Lake
Sourdough Creek
Lick Creek
Wild Horse Creek
Hyalite Reservoir
East Fork
Hyalite Creek
West Fork Hyalite Creek
Hyalite Creek (Middle)
Mont. 458
Bozeman
Mont. 345
Bozeman
Cottonwood Canal
Creek
Cottonwood
South
Belgrade
U.S. 191
Gallatin Gateway
Big Bear Creek
Little Bear Creek
Wilson Creek
West Gallatin River
West Yellowstone
Squaw Creek
Logger Creek
Spanish Creek
R 6 E
R 5 E
R 4 E
T 3 S
T 4 S



CONTOUR	ACRES FLOODED
127.5	30
132.5	40.4
137.5	50
142.5	59
147.5	69
152.5	80
157.5	91
162.5	101.6
167.5	113
172.5	124
177.5	135.6
182.5	147.4
187.5	159.6
192.5	175
197.5	196.4
202.5	222.4
207.5	249.2

	CONTOUR	AC. FT. STORAGE
	110	-209
	115	-179
	120	-109
	125	0
	130	150
	135	352
	140	602
	145	897
	150	1242
	155	1642
	160	2097
	165	2605
	170	3170
	175	3790
	180	4468
	185	5205
	190	6003
	195	6878
	200	7860
SPILLWAY CREST —	200.75	8027
	205	8972
	210	10218

MIDDLE CREEK RESERVOIR

STORAGE CURVE

GALLATIN COUNTY PROJECT NO. 422

NEVADA CREEK

Introduction

The project in Powell County, Montana, consists of a reservoir on Nevada Creek and a canal distribution system. Some of the users utilize the two canals in the system, and others divert water directly out of Nevada Creek or its tributaries. Several users upstream from the reservoir use prior right water in exchange for reservoir water which is delivered to users below the reservoir who have the aforementioned prior rights. The North Side Canal, which has a separate project number, is also a part of this project. The project was financed with a loan and grant from the Public Works Administration and with State Water Conservation Board funds. Construction was completed in 1940.

Water Purchase Contracts and Finances

Currently there are contracts for 6,095 acre feet. The charges per acre food of water are $1.05 for principal and $.95 for O & M making a total annual charge of $2.00. The O & M charges have remained constant for several years. The project has an adequate reserve fund.

The book charge as of June 30, 1972, was $61,680.79. There are water purchase contracts for future water sales in the amount of $65,126.25. With the present water purchase contracts, there will be an overrecovery of $3,445.46, and there is a potential for additional water sales.

Water Rights

The Department has the following filed water rights:

1. Nevada Creek and tributaries, September 1, 1937 for all unappropriated waters.

Measuring Devices

The Department maintains a continuous recorder on Nevada Creek. There are measuring devices on all turnouts, half of which have meter gates and half of which have Penvane boxes. Because Nevada Creek is an adjudicated stream, all the water is measured by a water commissioner.

Inspection Report

An inspection of the project was performed on October 3, 1972. The inspection report includes the following notations:

1. Debris on the face of the dam.
2. Some pitting of the gate, the stem guard, and the metal liner of the outlet tube.
3. Some possible cavitation below the spillway floor. Most of the necessary repairs are in progress or have been completed. The spillway floor has been a problem for a number of years. It has been patched several times, and the water users are going to patch it again. However, a new floor may be needed if deterioration continues.

Operation and Maintenance

Major repairs over the past few years have included patching the spillway, replacing the concrete outlet to the conduit and repairing the concrete measuring weir below the outlet. Seepage from the North Side Canal has been a problem, and an affected landowner has threatened court action. One year no water was delivered through this canal because of the threat. This year the landowner cooperated, and the Nevada Creek Water Users Association was able to use the canal.

Engineering Data

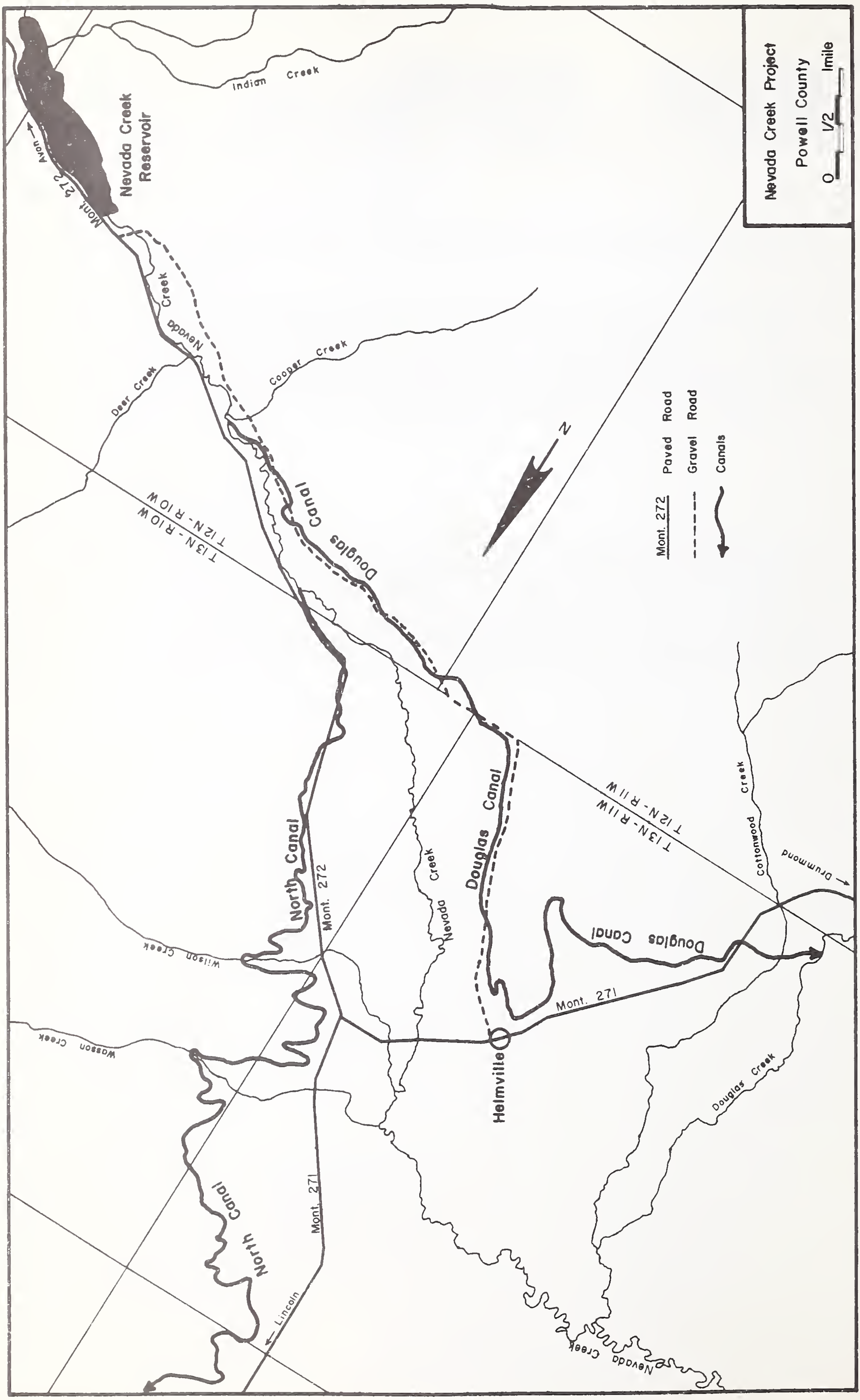
DAM:

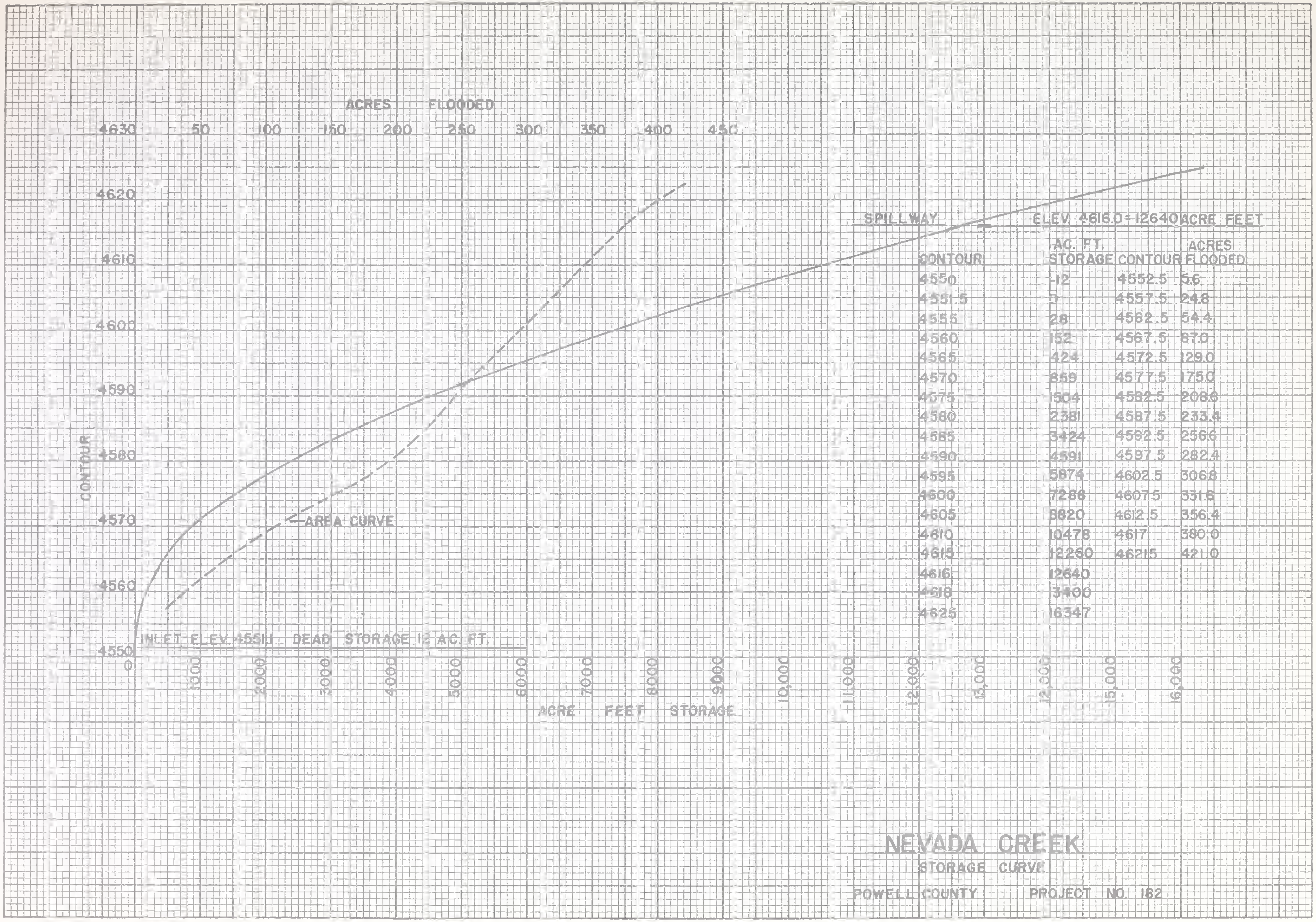
Storage:	12,640 A.F.
Spillway:	Width 100' Capacity 9,000 cfs
Gates:	1-54" dia. Slide and 1 - 54" dia. Pivot -- Dry Tower
Height:	83'
Length:	1,195'
Type:	Earth Fill -- 386,500 cu. yds.
Content Measuring Device:	Cable Down Face
Initial Cost:	$566,410.58

CANAL:

Douglas:	12.6 miles Capacity 50 cfs
North:	13.4 miles Capacity 49 cfs
Measuring Devices:	Water Stage Recorders

R/W Reservoir Pool: 375 Acres Deeded
Reservoir Land: 183.54 Acres Deeded
Douglas Canal: 73.19 Acres Partially Deeded
North Canal: No Deeds


Nevada Creek Project
Powell County
0
1/2
1mile
Mont. 272 Paved Road
Gravel Road
Canals
N
Nevada Creek Reservoir
Avon
Mont 272
Indian Creek
Nevada Creek
Cooper Creek
Deer Creek
Douglas Canal
T13N-R10W
T12N-R10W
T12N-R11W
T13N-R11W
North Canal
Mont. 272
Nevada Creek
Douglas Canal
Wilson Creek
Wasson Creek
Helmville
Mont. 271
Douglas Canal
Cottonwood Creek
Drummond
Douglas Creek
Mont. 271
North Canal
Lincoln
Nevada Creek



SPILLWAY ELEV. 4616.0 = 12640 ACRE FEET

CONTOUR	AC. FT. STORAGE	CONTOUR	ACRES FLOODED
4550	-12	4552.5	5.6
4551.5	5	4557.5	24.8
4555	28	4562.5	54.4
4560	152	4567.5	87.0
4565	424	4572.5	129.0
4570	859	4577.5	175.0
4575	1504	4582.5	208.6
4580	2381	4587.5	233.4
4585	3424	4592.5	256.6
4590	4591	4597.5	282.4
4595	5874	4602.5	306.8
4600	7286	4607.5	331.6
4605	8820	4612.5	356.4
4610	10478	4617	380.0
4615	12260	46215	421.0
4616	12640		
4618	13400		
4625	16347		

NEVADA CREEK

STORAGE CURVE

POWELL COUNTY PROJECT NO. 182

NILAN-FLORENCE

Introduction

These projects are located near Augusta in Lewis and Clark County, Montana. The Nilan Project supplies water to the Florence Canal and other water users. The reservoir has a storage capacity of 10,092 acre feet. Both projects were financed with State general funds. The Nilan Project was completed in 1951, and the Florence Canal Project was completed in 1955. Considerable work has been done on the Florence Project in order to make it operable.

Water Purchase Contracts and Finances

Twenty-five users, members of the Nilan Water Users Association, hold forty-one contracts for 3,383 acre feet on the Nilan Project and 1,640 acre feet on the Florence Canal Project. Yearly charges per acre foot for the Nilan Project include $1.00 for construction and $.90 for O&M, for a total of $1.90 per acre foot. The Florence Canal users also pay an extra $.75 per year for construction charges and $.90 per year for O&M charges, for a total of $1.65 per acre foot. Both projects are under fifty year contracts. The O&M charge reflects a $.15 increase in 1972 to start a reserve fund.

As of June 30, 1972, book charges for the Nilan Project totaled $346,798.32. Expected future revenue from water purchase contracts was $122,945.00, leaving an overall shortage of $223,853.32. Book charges for Florence totaled $176,260.13 on the same date, and expected future revenue from water purchase contracts totaled $19,110.30. There is also a repayment contract balance of $12,965.00. This leaves an overall shortage of $144,184.83. The total shortage based on present Water Purchase Contracts for the two projects is $368,038.15 under the initial State investment.

Water Rights

On August 22, 1950, the Department filed for all unappropriated waters on Ford Creek and its tributaries and Smith Creek and its tributaries.

Measuring Devices

There are twenty turnouts on the projects, most of which have concrete headwalls and screw-slide gates. There are some Parshall flumes and one meter gate. The Department maintains a continuous recorder on each project.

Inspection Report

An October 4, 1972, inspection report includes the following notations:

1. Upstream faces of both dams need riprap. A design and cost estimate is needed.
2. Seepage has caused small calcium deposits in the tunnel.
3. A large volume of seepage is coming from the north dam, and a drain should be put across the toe of the dam to intercept this seepage. The present drain system also needs repairs.

4. The tunnel of the north dam is cracked and grouting may become necessary.
5. The channel below the outlet is filled with sediment, and willow trees in the channel should be removed.

Operation and Maintenance

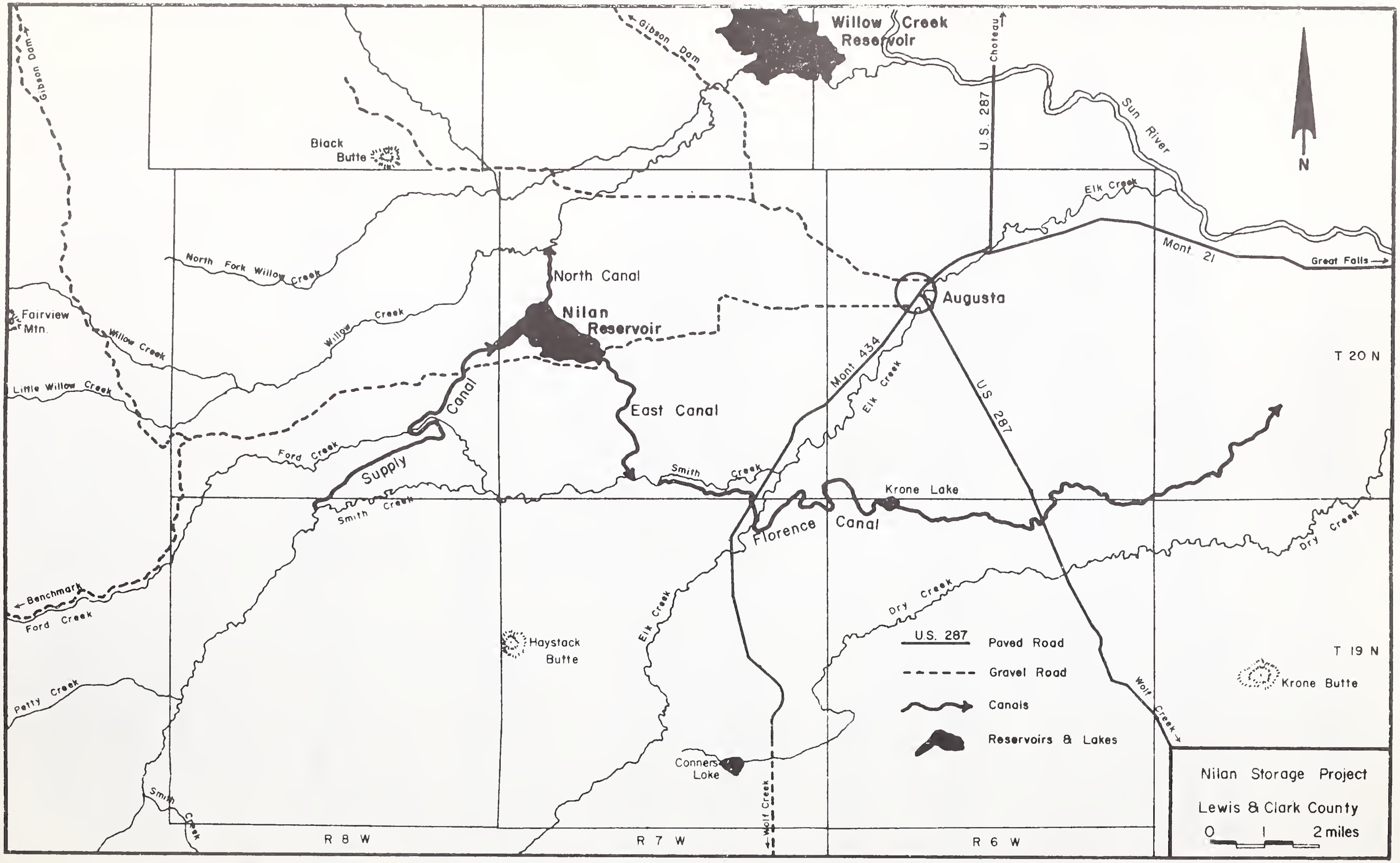
The Florence Canal was repaired in 1967 with 325 lineal feet of concrete lining to prevent seepage above the Nickol's Ranch. In 1970, another portion of the canal was lined.

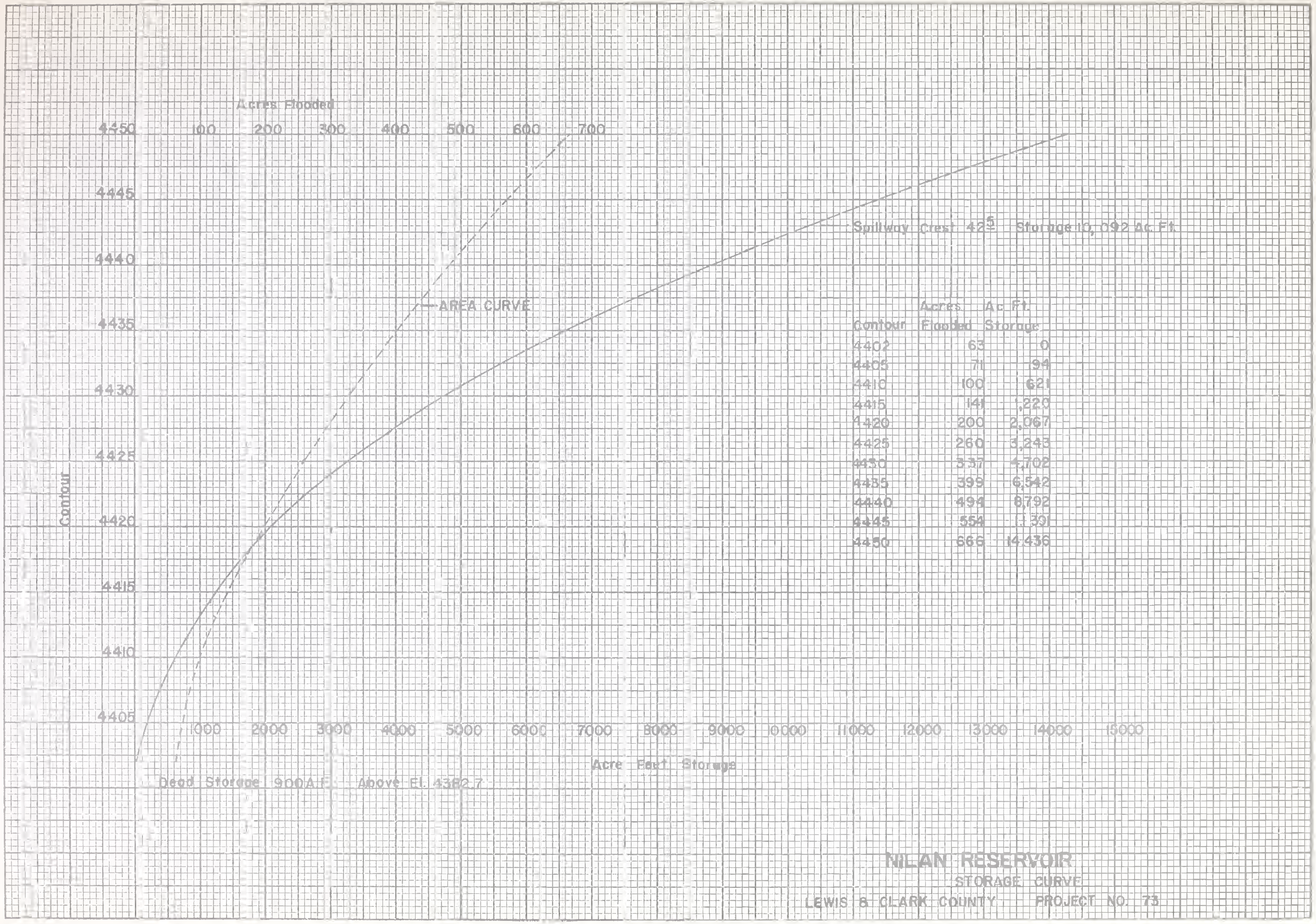
Additional concrete lining is needed on the canal. Some preliminary investigations by the Soil Conservation Service were underway but ceased with the end of the REAP program. There is also a severe erosion problem at the end of the canal, and some type of drop structure should be installed.

There is interest in further irrigation development on this project, and some studies have begun. Physical improvements, such as constructing new canals and increasing capacity of existing structures, will be needed for most new development.

Engineering Data

DAM:	
Off Stream Storage:	10,092 A.F.
Gates:	East Dam: 1 - 48" x 48" and 1 - 48" diameter Slide -- Wet Tower North Dam: 1 - 48" x 48" and 1 - 48" diameter Slide -- Wet Tower
Height:	East Dam: 44' North Dam:34'
Length:	East Dam: 1,010' North Dam: 530'
Type:	Earth Fill -- 125,000 cu. yds.
Content Measuring Device:	Tape in East Tower
Initial Cost:	$561,164.41
CANALS:	
Supply:	5.47 miles Capacity 300 cfs
Outlet:	5.2 miles Capacity 74 cfs
Florence:	16.25 miles Capacity 85 cfs
Measuring Devices:	Water Stage Recorders on All Canals.
R/W Reservoir Pool:	535 Acres Deeded
Reservoir Land:	207.26 Acres Deeded
Supply Canal:	25.09+ Acres Deeded Partially
Outlet Canal:	15.6+ Acres Deeded Partially
Florence Canal:	269.11 Acres Deeded Partially


Nilan Storage Project
Lewis & Clark County
0 1 2 miles
N
U.S. 287 Paved Road
Gravel Road
Canals
Reservoirs & Lakes
Willow Creek Reservoir
Gibson Dam
Choteau
U.S. 287
Sun River
Black Butte
Elk Creek
Mont 21
Great Falls
North Fork Willow Creek
North Canal
Nilan Reservoir
Augusta
Fairview Mtn.
Willow Creek
Little Willow Creek
Mont 434
US 287
T 20 N
Canal
East Canal
Ford Creek
Supply
Smith Creek
Krone Lake
Florence Canal
Dry Creek
Benchmark
Haystack Butte
Conners Lake
Wolf Creek
T 19 N
Krone Butte
Petty Creek
R 8 W
R 7 W
R 6 W



Contour	Acres Flooded	Ac. Ft. Storage
4402	63	0
4405	71	194
4410	100	621
4415	141	1,220
4420	200	2,067
4425	260	3,243
4430	337	4,702
4435	399	6,542
4440	494	8,792
4445	554	11,391
4450	666	14,436

NILAN RESERVOIR
STORAGE CURVE
LEWIS & CLARK COUNTY PROJECT NO. 73

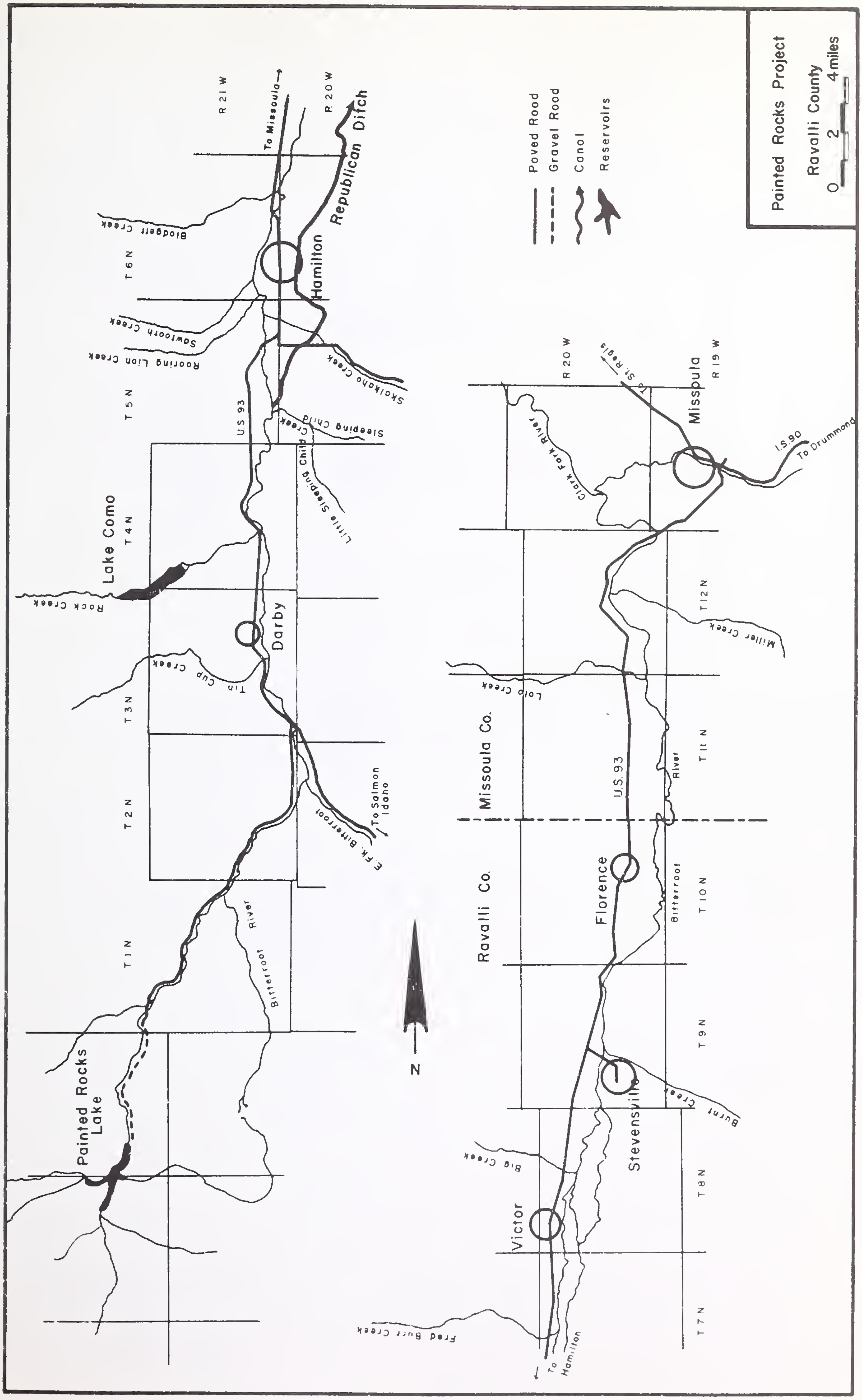
PAINTED ROCKS (WEST FORK OF THE BITTERROOT)

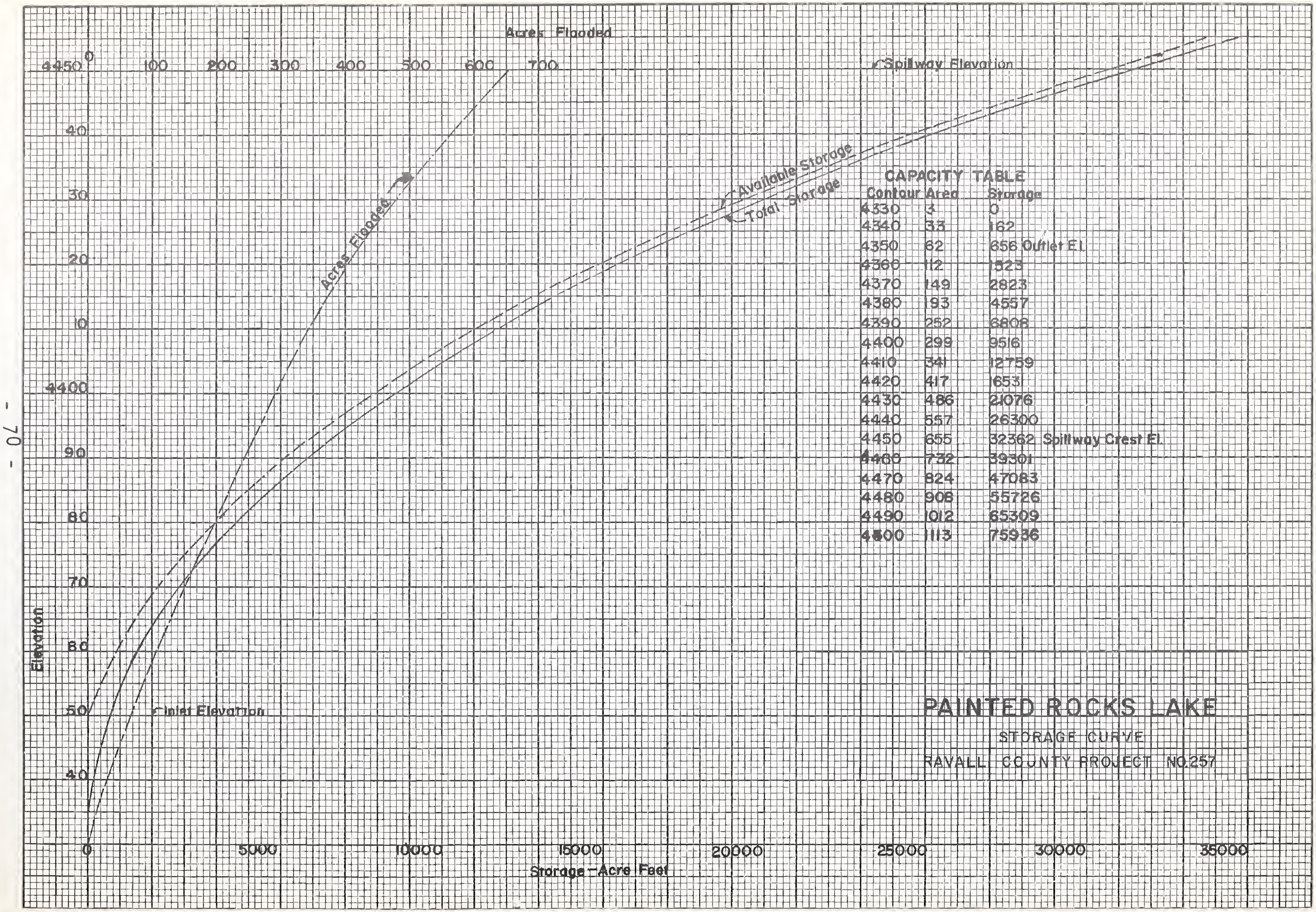
This project, consisting of a dam and reservoir, is located on the West Fork of the Bitterroot River about thirty miles south of Darby in Ravalli County, Montana. Storage capacity of the project is 32,362 acre feet. Construction of the project, which was financed with federal grant and loan funds and State general funds, was completed in 1939.

There is no active water users association on this project. Water from the reservoir, however, is sold to the Montana Fish & Game Department and to the Daly Ditches Water Users. The Fish & Game Department buys 5,000 acre feet of water per year. Its water purchase contract, now paid in full, amounted to $110,400.00. It pays an O&M charge of $500.00 per year. The Daly Ditch Water Users purchase 1,000 acre feet of water per year, for which they are charged $1,400.00 annually.

Engineering Data

DAM:		
	Storage:	32,362 A.F.
	Spillway:	Width 160' Capacity 26,000 cfs
	Gates:	2 - 5' x 8' Slide -- Wet Tower
	Height:	143'
	Length:	800'
	Type:	Earth Fill -- 853,000 cu. yds.
	Measuring Device:	Tape in Tower
	Initial Cost:	$991,270.27
W/R	Reservoir Pool:	655 Acres Deeded & U.S.F.S. Permit
	Reservoir Land:	383.33 Acres Deeded & U.S.F.S. Permit


Painted Rocks Project
Ravalli County
0 2 4 miles
Paved Road
Gravel Road
Canal
Reservoirs
N
Painted Rocks Lake
Lake Como
Rock Creek
Darby
Tin Cup Creek
Hamilton
Republican Ditch
To Missoula
R 21 W
R 20 W
Blodgett Creek
Sawtooth Creek
Roaring Lion Creek
Skalkaho Creek
Sleeping Child Creek
Little Sleeping Child
U.S. 93
E. Fk. Bitterroot
To Salmon Idaho
Bitterroot River
T 1 N
T 2 N
T 3 N
T 4 N
T 5 N
T 6 N
Missoula
To St. Regis
R 20 W
R 19 W
I.S. 90
To Drummond
Clark Fork River
Miller Creek
Lolo Creek
Missoula Co.
Ravalli Co.
Florence
Bitterroot River
Stevensville
Burnt Creek
Big Creek
Victor
Fred Burr Creek
To Hamilton
T 7 N
T 8 N
T 9 N
T 10 N
T 11 N
T 12 N



CAPACITY TABLE

Contour	Area	Storage
4330	3	0
4340	33	162
4350	62	656 Outlet El.
4360	112	1523
4370	149	2823
4380	193	4557
4390	252	6808
4400	299	9516
4410	341	12759
4420	417	16531
4430	486	21076
4440	557	26300
4450	655	32362 Spillway Crest El.
4460	732	39301
4470	824	47083
4480	908	55726
4490	1012	65309
4500	1113	75936

PAINTED ROCKS LAKE

STORAGE CURVE

RAVALLI COUNTY PROJECT NO.257

PARADISE CANAL

Introduction

This project is located in Park County, Montana, on the east side of the Yellowstone River, south of Livingston. The water is siphoned under the Yellowstone through a 506 foot long 48" concrete siphon from the Park Branch Canal. The canal is 11.2 miles long and has a capacity of 3,300 miners' inches. The project was completed in 1957.

Water Purchase Contracts and Finances

Twenty users hold 25 contracts for 2,955 MI on the project. Construction charges are $2.00 per MI per year, and Operation and Maintenance charges are $1.50 per MI per year. The Paradise Canal Water Users' Association has started a reserve fund which will be held in certificates of deposit.

Book charges on June 30, 1972, were $278.112.77, and revenue from future water purchase contract payments amounts to $238,285.00. This leaves a shortage of $39,827.77 under the state's initial investment.

Water Rights

The Paradise Canal project uses water from the Park Branch Canal. Therefore, the same water right applies to both projects. Also, the Department appropriated 250 cfs of the unappropriated waters of the Yellowstone River on October 23, 1935.

Measuring Devices

The project has 28 turnouts with concrete headwalls. There are 28 measuring devices, which include 22 orifice gates, 4 meter gates and 2 weir spillways, but most of these measuring devices are inoperative. The Department maintains a continuous recorder at the beginning of the canal.

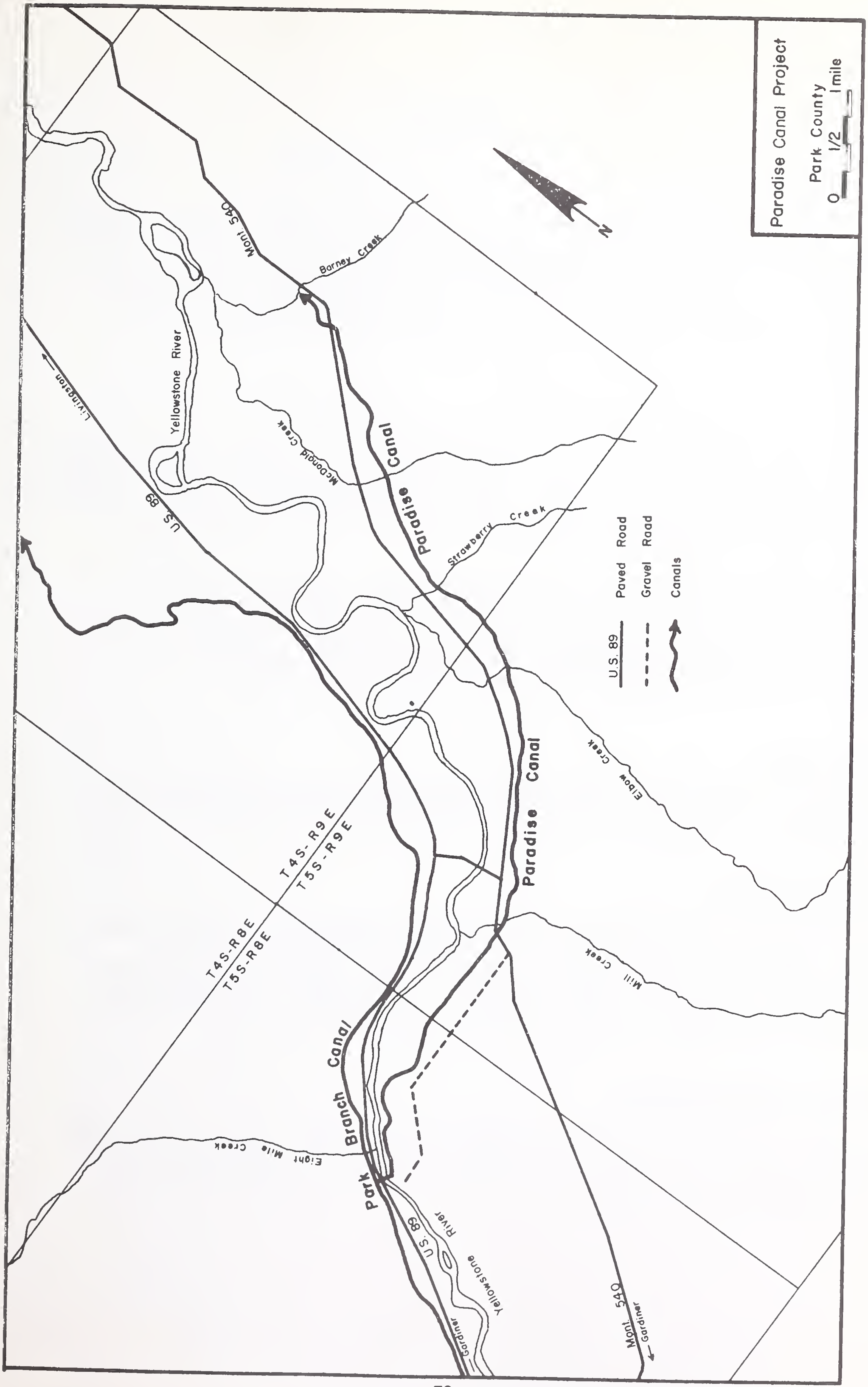
Operation and Maintenance

The canal narrows very rapidly, making it difficult to adjust the amount of flow to the needs of the users. There are at least four locations on the canal which experience washouts every few years. The Association is presently contemplating lining part of the canal with concrete.

Engineering Data

DAM:	None
Headgate:	1 - 48" diameter Slide in Park Branch Canal
Initial Cost:	$351,033.37

CANAL:	11.2 miles Capacity 85 cfs 506' of 48" Concrete Pipe Siphon
Measuring Device:	Water Stage Recorder
R/W Canal	104.33+ Acres Deeded Partially


Paradise Canal Project
Park County
0
1/2
1 mile
N
U.S. 89
Paved Road
Gravel Road
Canals
Mont. 540
Barney Creek
Livingston
Yellowstone River
McDonald Creek
Paradise Canal
U.S. 89
Strawberry Creek
Elbow Creek
Paradise Canal
T4S-R9E
T5S-R9E
T4S-R8E
T5S-R8E
Mill Creek
Park Branch Canal
Eight Mile Creek
U.S. 89
River
Yellowstone
Gardiner
Mont. 540
Gardiner

PARK BRANCH

Introduction

This is a direct diversion project taking water from the Yellowstone River approximately three miles above Emigrant in Park County, Montana. The canal is 20.9 miles long and has an initial capacity of 266 cubic feet per second. Construction of the project, which was financed by a loan and grant agreement from the Public Works Administration together with State Water Conservation Board funds, was completed in 1937.

Water Purchase Contracts and Finances

Twenty-seven users presently hold 66 contracts for 8,007 MI. Construction charges amount to $1.00 per miners' inch per year, and O & M charges amount to $.80 per miners' inch per year, making a total charge of $1.80. Part of the O & M is set aside for a reserve fund which is held in the form of certificates of deposit.

Book charges to the project as of June 30, 1972, totaled $47,941.73. Repayment through water purchase contracts will total $47,715.00. A $1.19 credit is given for overrepayment on a repayment contract. This results in a shortage of $227.92, less than the state's initial investment, but this amount will be repaid through O & M funds.

Water Rights

A filing was made by the State Water Conservation Board for 250 cfs of the unappropriated waters of the Yellowstone River on October 23, 1935.

Measuring Devices

The project has thirty turnouts with concrete headwalls and metal screw gates. Twenty of these turnouts have Parshall flumes, and the Park Branch Water Users' Association plans to install Parshall flumes on the remaining ten turnouts in the next two or three years. The Department maintains a continuous recorder at the beginning of the canal.

Operation and Maintenance

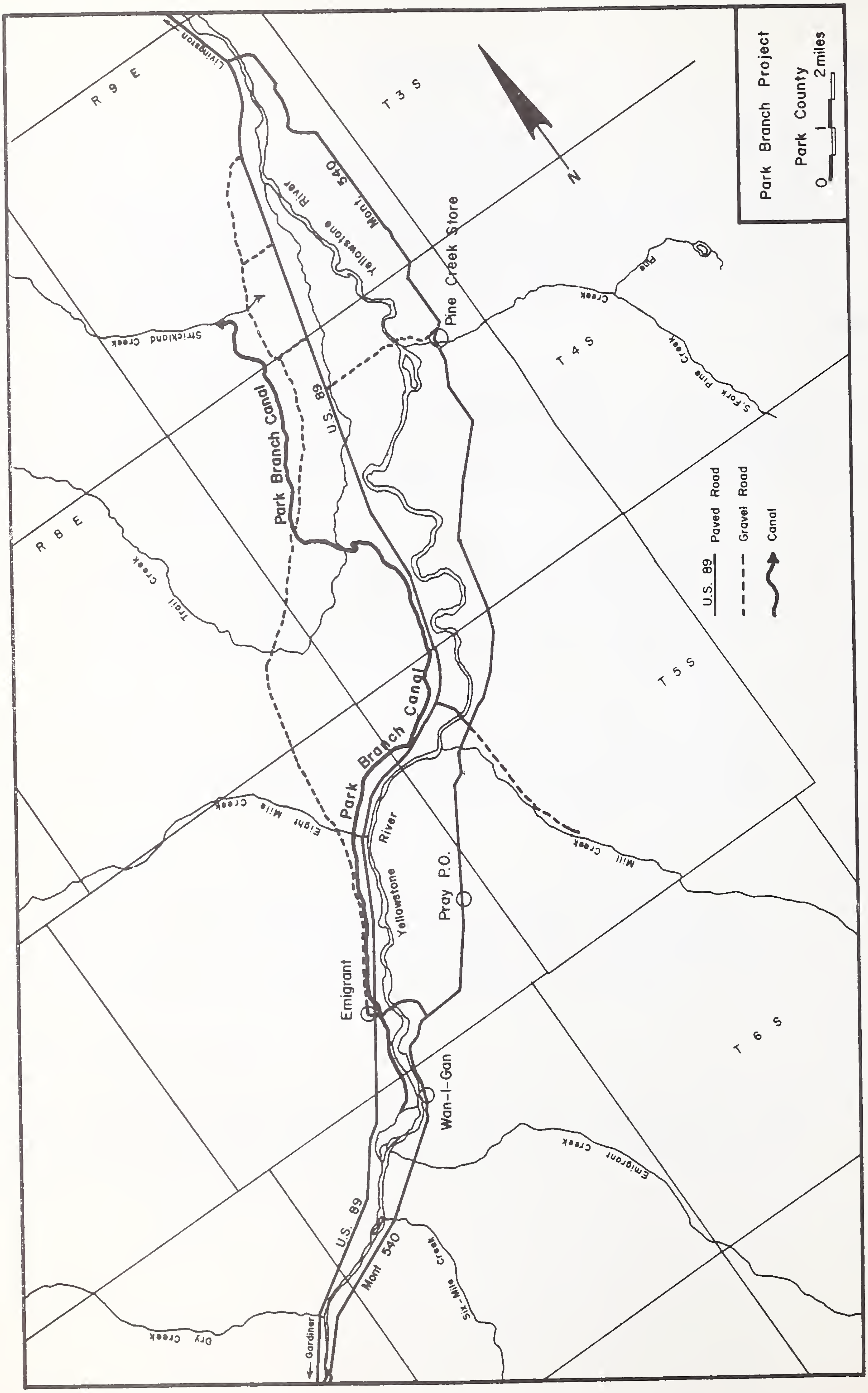
The major maintenance problem is breaks in the canal. Parts of the canal traverses steep hillsides, and the canal washes out in these areas. Repairing these breaks has not been a major expense, but deliveries are interrupted when they occur.

DAM:

Storage:	Direct Diversion
Spillway:	Width 88'
Gates:	4 - 42" x 60" Slide Headgate
Height:	5'
Length:	87'
Type:	Concrete Diversion Weir with Timber Stop Planks
Initial Cost:	$280,902.98

CANAL:

	20.9 miles
	Capacity 350 cfs
Measuring Device:	Water Stage Recorder
R/W Canal	190.93 Acres Deeded


Park Branch Project
Park County
0 1 2 miles
N
U.S. 89 Paved Road
Gravel Road
Canal
Livingston
R 9 E
R 8 E
T 3 S
T 4 S
T 5 S
T 6 S
Mont. 540
Yellowstone River
Pine Creek Store
Pine Creek
S. Fork Pine Creek
Strickland Creek
Park Branch Canal
U.S. 89
Trail Creek
Eight Mile Creek
Mill Creek
Pray P.O.
Emigrant
Wan-I-Gan
Emigrant Creek
Six-Mile Creek
Mont 540
Dry Creek
Gardiner

PETROLIA

Introduction

The Petrolia project, consisting of a storage dam, a main canal, a relift canal, a drop to Flatwillow Creek and a short pump line, is located on Flatwillow Creek nine miles southeast of Winnett in Petroleum County, Montana. Construction was financed with State Water Conservation Board funds and was completed in 1951.

Water Purchase Contracts and Finances

Nineteen users hold forty-six contracts for 2,989 acres. Each user is allowed one and one-half acre feet of water per acre of land under contract. The Petrolia Water Users' Association pays $2.00 per acre per year for construction charges, $1.38 per acre per year for O & M charges, and $1.00 per acre per year for a special assessment, making the total charge of $4.38 per acre per year.

Book charges for the project as of June 30, 1972 amounted to $472,046.79. Revenue from water purchase contracts for future water sales will be $208.812.00, and the Association has a repayment contract balance of $49,951.41. This leaves an overall shortage of $213,283.35.

Water Rights

The State Water Conservation Board filed for all unappropriated waters on Elk Creek and Flatwillow Creek on March 13, 1950. It also filed for all unappropriated waters on Johnson Coulee and all tributaries on July 19, 1947.

Inspection Report

An October 11, 1972, inspection report includes the following notations:

1. There is extreme seepage through the dam abutments.
2. The pedestal lift for the outlet canal is broken.
3. The spillway banks, which are eroded and damaged by livestock, should be riprapped and fenced. There is a large hole in front of the spillway which should be filled and armored with riprap. Brush should be removed from the spillway walls, and the spillway concrete should be patched.
4. The spillway is used more than it should be due to a limited operating channel capacity and lack of runoff predictions.

A complete engineering and geological study is needed to determine the stability of the dam.

Recent Major Repairs

Approximately eight miles of the main canal were cleaned and regraded in 1962. In 1967, the rock riprap on the face of the dam was repaired and approximately three and one half miles of canal were lined with concrete. In 1970, repairs were made to the concrete floor of the spillway, the channel below the spillway was enlarged and exploration drilling was done above the spillway.

Future Repairs or Plans

The Association has expressed an interest in raising the dam to gain further storage capacity. This possibility will be considered, along with other work needed on the dam. Some field work for the critique has been done, including a rating of the expected life of each structure.

Engineering Data

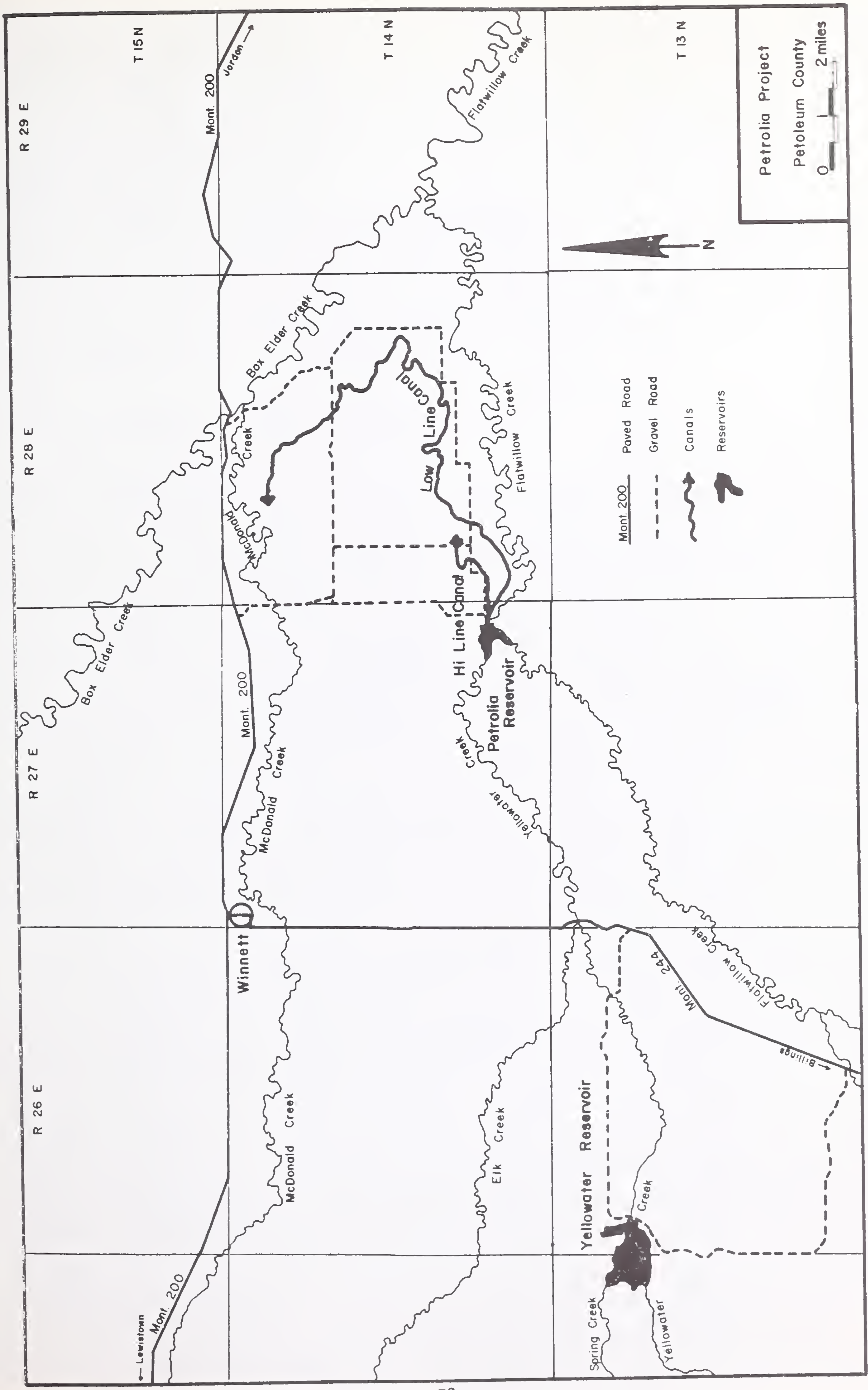
DAM:

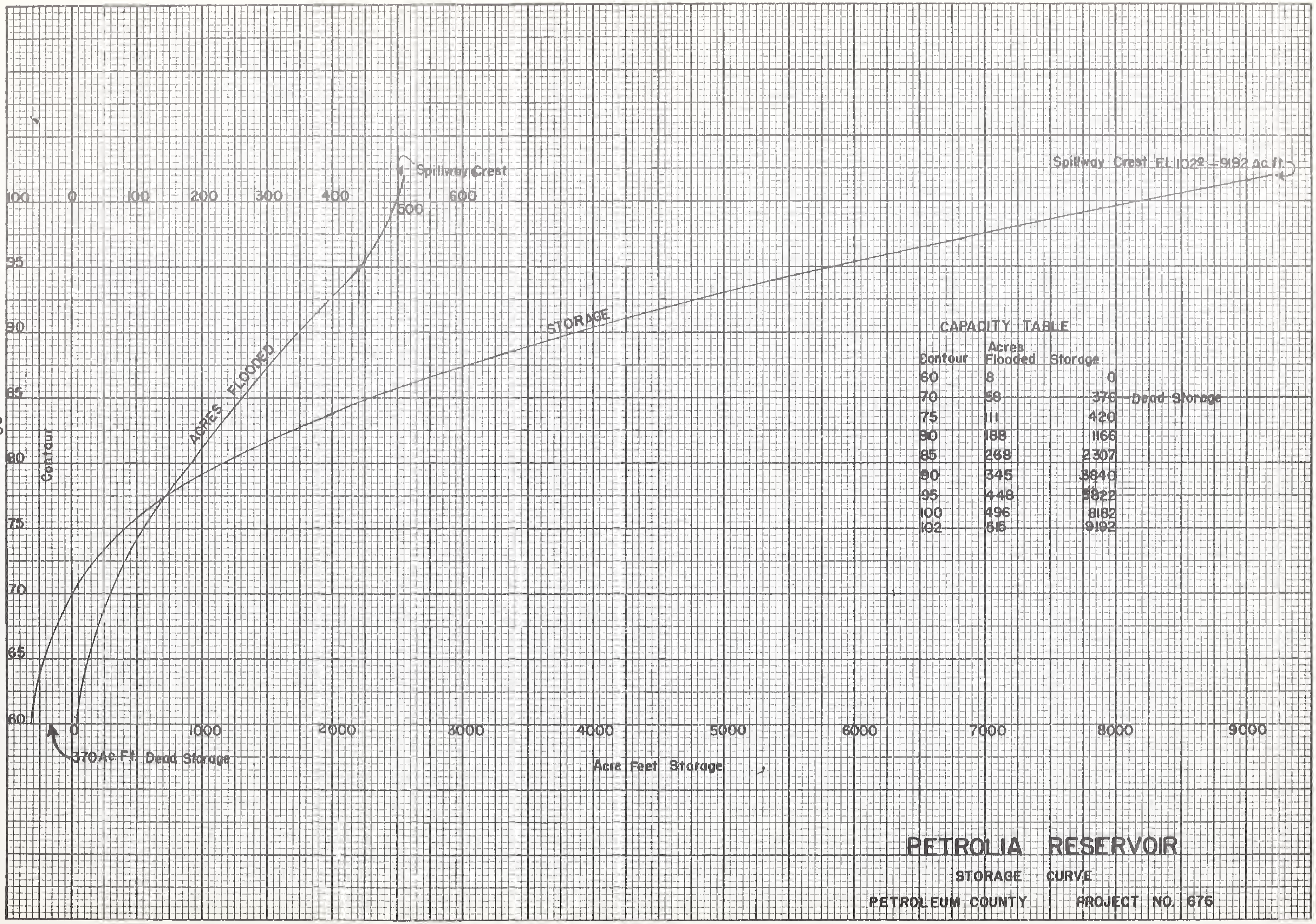
Storage:	9,102 A.F.
Spillway:	Width 100' Capacity 7,000 cfs
Gates:	1 - 60" x 60" Slide and 1 - 60" Diameter Slide 1 - 30" dia. Slide on Relift Canal -- Wet Tower
Height:	55'
Length:	966'
Type:	Earth Fill -- 300,000 cu. yards
Content Measuring Device:	Tape in Tower
Initial Cost:	$492,472.54

CANAL:

Main:	12.67 miles
Relift:	1.33 Miles
Drop to Creek:	1 - 60" dia. Slide Gate
Pumpline:	60' of 16" Metal Pipe

R/W	Reservoir Pool:	515 Acres Deeded
	Reservoir Land:	226.91 Acres Deeded
	Main Canal	112.72 Acres Deeded
	Re-Lift Canal	10.78 Acres Deeded


Petrolia Project
Petoleum County
0
2 miles
N
Mont. 200
Paved Road
Gravel Road
Canals
Reservoirs
T 15 N
T 14 N
T 13 N
R 29 E
R 28 E
R 27 E
R 26 E
Jordon
Mont. 200
Flatwillow Creek
Box Elder Creek
McDonald Creek
Low Line Canal
Flatwillow Creek
Hi Line Canal
Petrolia Reservoir
Box Elder Creek
Mont. 200
McDonald Creek
Yellowater Creek
Winnett
Mont. 244
Flatwillow Creek
Billings
McDonald Creek
Elk Creek
Yellowater Reservoir
Creek
Lewistown
Mont. 200
Spring Creek
Yellowater



CAPACITY TABLE

Contour	Acres Flooded	Storage	
60	8	0	
70	58	370	Dead Storage
75	111	420	
80	188	1166	
85	268	2307	
90	345	3840	
95	448	5822	
100	496	8182	
102	516	9192	

PETROLIA RESERVOIR

STORAGE CURVE

PETROLEUM COUNTY PROJECT NO. 676

ROCK CREEK (COONEY)

Introduction

This project, which consists of two storage reservoirs and some small canals, is located in Carbon County, Montana. The reservoirs are known as Cooney Reservoir and Glacier Lake. Financed with a loan and grant from the Public Works Administration and with State Water Conservation Board funds, the project was completed in 1937. Cooney Reservoir receives heavy recreational use, and the Montana Fish & Game Department maintains the recreational area.

Water Purchase Contracts and Finances

There are presently water purchase contracts for 17,450 acre feet. With current operation practices, this amount is approximately the firm annual yield of the project. The charge for water is $1.00 for principal, $.15 O&M, and $.10 for a special assessment, making a total charge of $1.25 per acre foot. The project has an adequate reserve fund. The Rock Creek Water Users' Association operates only the dams, and the water is distributed through private diversions and canals from the creek.

The book charge on June 30, 1972, was $47,203.35. Water purchase contracts for future water sales amount to $266,095.00 and a repayment contract with the Association has an outstanding balance of $10,942.50. Therefore, there will be an overrecovery on this project of $229,834.15.

Water Rights

The Department holds the following rights for this project:

1. A decreed right on Willow Creek, May 1, 1896, for 150 MI.
2. A decreed right on Willow Creek, May 1, 1896, for 100 MI.
3. A filed right on Rock Creek for Glacier Lake Reservoir on May 10, 1934, for all unappropriated waters.
4. A filed right on Red Lodge Creek (Cooney Reservoir) on May 10, 1934, for all unappropriated waters.

Measuring Devices

A continuous recorder is maintained by the United States Geological Survey at the outlet of Cooney Dam. Water deliveries to individual users are controlled by a water commissioner using Parshall flumes.

Inspection Report

Inspections of both Cooney Dam and Glacier Lake Dam were performed during the summer of 1972. The inspection reports include the following notations:

Cooney Reservoir

1. There is a large amount of seepage coming through the dam, especially in the area of the outlet.
2. The control gate and much of the other metal in the outlet is severely pitted.
3. Wing walls of the outlet are cracking and crumbling, and the fill behind the wing walls has eroded.
4. Repairs and additions are needed to the drainage system.
5. The outlet channel needs to be cleaned and regraded, and the weir needs to be backfilled and protected with riprap.
6. The face of the dam needs extensive riprap.
7. The spillway is in poor condition.

Plans are now being made for extensive repairs, and the dam is being operated carefully to prevent further damage.

Glacier Lake

1. A considerable amount of debris is found along the face of the dam and blocks the spillway.
2. A few other items require minor maintenance or observation.

Operation and Maintenance

Repair to the spillway at Cooney Dam has been necessary whenever the spillway has been used. The reservoir is now operated at a lower level to minimize the possibility of water going over the spillway and to reduce damage to the dam face. Snow surveys are used in managing the reservoir. Proposals have been made to replace the present spillway.

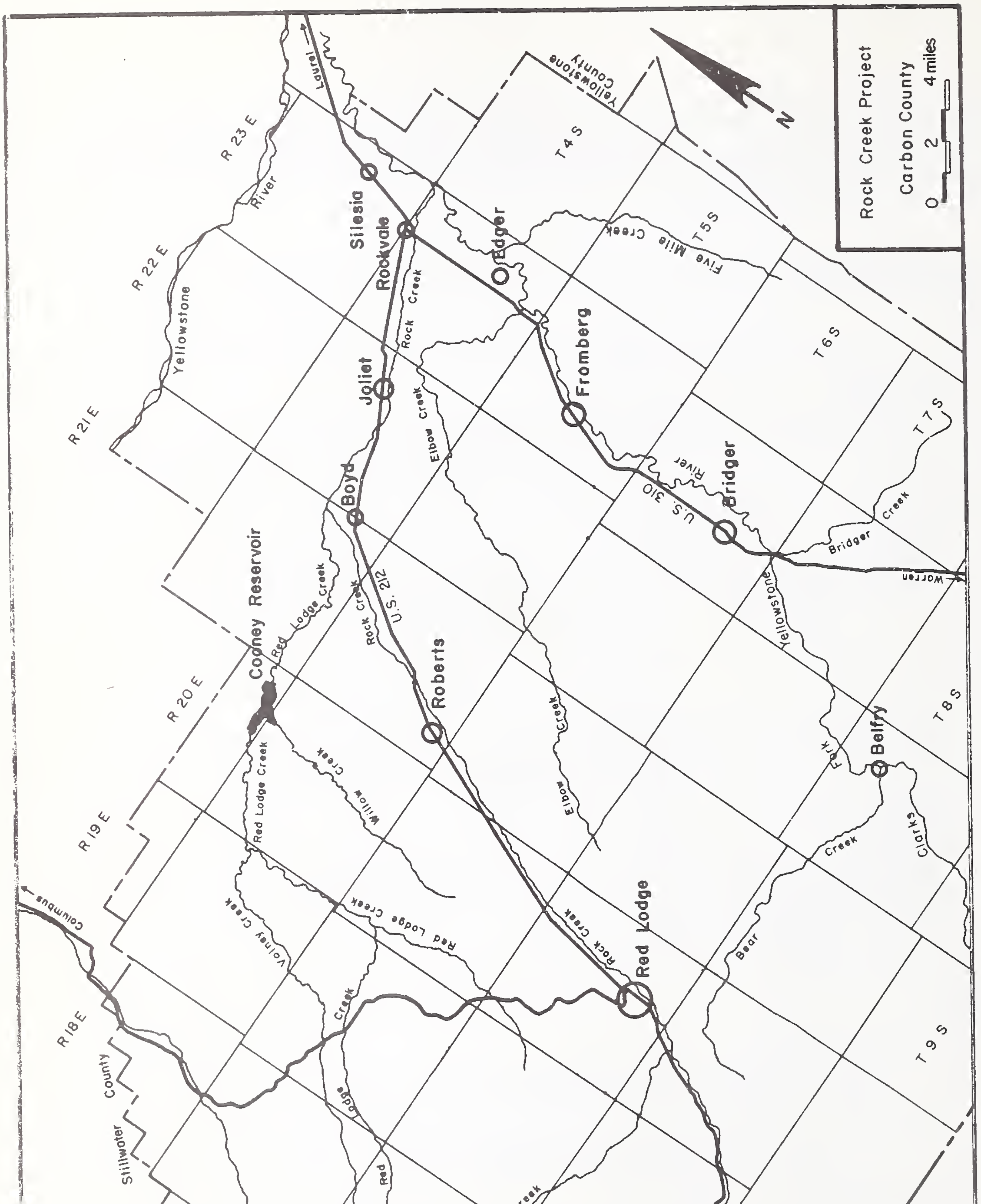
Another problem over the years has been seepage through the dam. In 1972, the rate of seepage increased substantially, and a detailed investigation of the problem will be made in 1973.

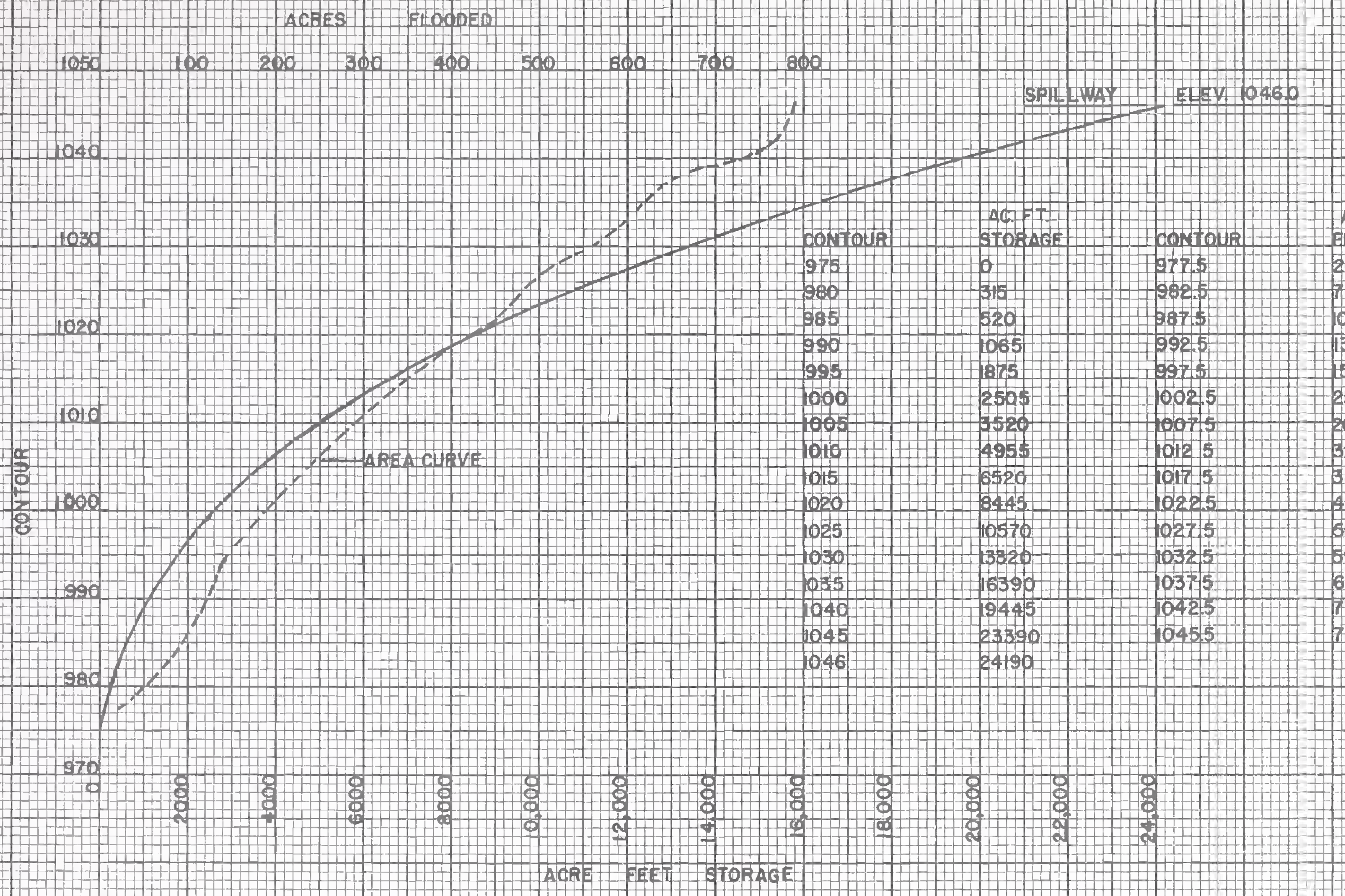
Two major repairs are planned for the near future. The riprap on the face of the dam has deteriorated and must be replaced, and the outlet structure to the conduit through the dam needs major repairs. A project for both items has been proposed as a part of the Beartooth Resource Conservation & Development Program.

The reservoir is apparently filling with sediment rapidly. The Montana Fish & Game Department sounded the lake recently and determined that the Reservoir now has a capacity of only 18,000 acre feet, compared to an initial capacity of 24,000 acre feet. A sediment study of the entire region is now in progress.

Engineering Data

DAM:		Cooney
	Storage:	24,195 A.F.
	Spillway:	Width 200' Capacity 12,000 cfs
	Gates:	1 - 60" diameter Slide and 1 - 60" Diameter Pivot Dry Tower
	Height:	97'
	Length:	2,260'
	Type:	Earth Fill -- 1,362,000 cu. yds.
	Content Measuring Device:	Cable down face of dam
DAM:		Glacier
	Storage:	4.200 A.F.
	Spillway:	Width 50' Capacity 1,450 cfs
	Gates:	1-48" x 48" slide
	Height:	65'
	Length:	260'
	Type:	Earth Fill -- 8,400 cu. yds.
	Content Measuring Device:	None
	Initial Cost:	$888,736.77
CANALS:		
	Point of Rocks:	2.3 miles Capacity 50 cfs
	Finn:	9 miles Capacity 25 cfs
	Cottonwood:	2 miles Capacity 25 cfs
	Pryde:	8 miles Capacity 40 cfs
R/W	Reservoir Pool	790 Acres Deeded (Cooney)
	Reservoir Land:	1.082.07 Acres Deeded (Cooney)
	Reservoir	165.87 Acres U.S.F.S. Permit (Glacier Lake)
	Point of Rocks	40.70 Acres Deeded (Canal)


Rock Creek Project
Carbon County
0 2 4 miles
N
U.S. 212
Paved Road
Gravel Road
Reservoir
Yellowstone County
Stillwater County
Montana
Wyoming
R 18 E
R 19 E
R 20 E
R 21 E
R 22 E
R 23 E
T 4 S
T 5 S
T 6 S
T 7 S
T 8 S
T 9 S
Laurel
Silesia
Rockvale
Edgar
Joliet
Fromberg
Boyd
Bridger
Roberts
Belfry
Red Lodge
Cooney Reservoir
Glacier Lake Reservoir
Cooke City
Columbus
Warren
Yellowstone River
Rock Creek
Five Mile Creek
Elbow Creek
Red Lodge Creek
Willow Creek
Volney Creek
Bridger Creek
Clarks Fork
Bear Creek
U.S. 310
West Red Lodge Creek
West Fork Rock Creek
Lake Fork
East Rosebud Creek



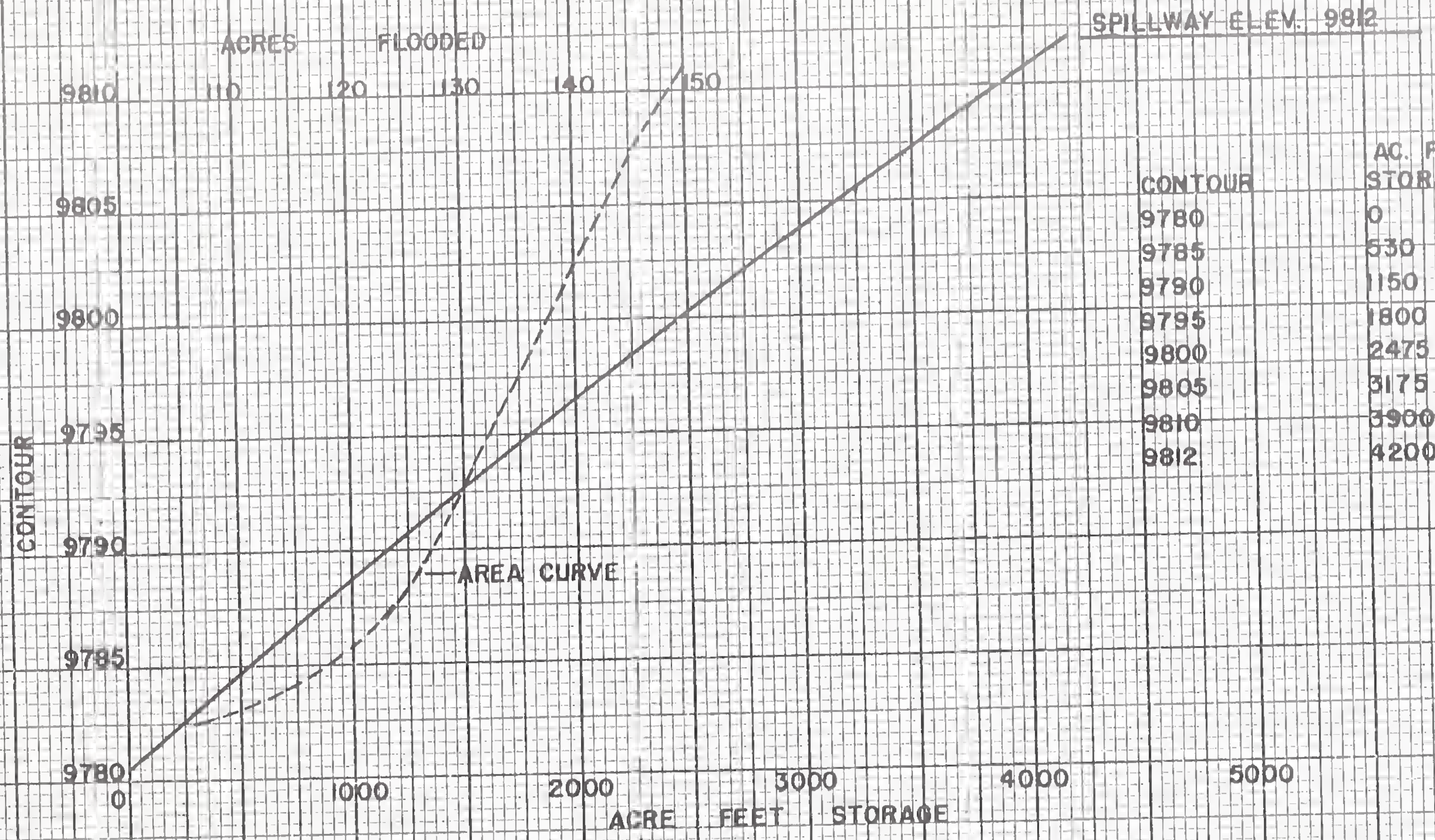
CONTOUR	AC. FT. STORAGE
975	0
980	315
985	520
990	1065
995	1875
1000	2505
1005	3520
1010	4955
1015	6520
1020	8445
1025	10570
1030	13320
1035	16390
1040	19445
1045	23390
1046	24190

CONTOUR	ACRES FLOODED
977.5	20
982.5	77
987.5	103
992.5	134
997.5	158
1002.5	216
1007.5	262
1012.5	326
1017.5	384
1022.5	460
1027.5	504
1032.5	598
1037.5	646
1042.5	774
1045.5	790

COONEY RESERVOIR

STORAGE CURVE

CARBON COUNTY PROJECT NO. 64



CONTOUR	ACRES FLOODED
9782.5	106
9787.5	124
9792.5	130
9797.5	135
9802.5	140
9807.5	145
9811	150

CONTOUR	AC. FT. STORAGE
9780	0
9785	530
9790	1150
9795	1800
9800	2475
9805	3175
9810	3900
9812	4200

GLACIER LAKE

STORAGE CURVE

CARBON COUNTY PROJECT NO. 64

RUBY RIVER

Introduction

The Ruby Reservoir and dam is located six miles south of Alder in Madison County, Montana. It has a capacity of 38,850 acre feet and floods an area of 950 acres when full. Water from this project is supplied through private diversions from Ruby River and through two Department-owned canals, the Vigilante Canal and the West Bench Canal. The construction of the dam, financed with a loan and grant from the Public Works Administration and with State Water Conservation Board funds, was completed in 1938.

Water Purchase Contracts and Finances

Currently there are contracts for 24,715 acre feet per year. The charge for the water is $.56 for principal and $.24 for O & M, for a total charge of $.80 per acre feet. The O & M rate has remained constant for several years, and an adequate reserve fund exists. The Ruby River Water Users Association operates the dam only.

Book charge on June 30, 1972 was $57,210.72. There are water purchase contracts for future water sales in the amount of $66,194.80. The state investment will, therefore, be overrecovered by $8,984.08. There may be additional water available, but further study will have to be made before more is sold.

Economic Analysis

The Ruby River Project was considered in the 1964 report by Elroy C. McDermott of the Department of Agricultural Economics of Montana State College. Following are some of his conclusions:

1. Irrigation is of vital importance to the economy of Madison County. It assures the production of sufficient winter feed to balance and stabilize the local livestock operation from which the majority of the county's income is derived.

2. One of the most important sources of irrigation water within the county is the Ruby River storage project. This project provides water to approximately 33,000 acres, of which approximately 13,000 receive a primary supply, and approximately 20,000 receive a supplementary supply.

3. The project has greatly reduced risk and uncertainty. Crops are now assured even in the driest years, and on normal years production is reported to be approximately doubled on supplementary acres. The project has enabled many previously marginal operations to become stable economic units.

4. During the last three decades, the standard of living of farm families in Madison County has been very favorable in comparison to the level for the State as a whole and also for the nation. This favorable

position can largely be attributed to the balanced livestock operations and the increased production of irrigated crops.

5. On lands of similar quality and fertility, the average difference in value between irrigated land and land which presently cannot be irrigated is approximately $154.00 per acre. This difference in price should represent the capitalized value of net returns to the water discounted over time.

6. The tax base of Madison County has been broadened considerably as a result of the Ruby River Project. It is assumed that the 13,000 acres of newly irrigated land were all previously classified as grazing land. The difference between the average assessed value of irrigated land and the average assessed value of grazing land was $23.28 per acre in 1962. This average increase on 13,000 acres would amount to a broadening in the tax base of approximately $302,640.00

   It is assumed that the 20,000 supplemental acres were all previously assessed as irrigated lands and have not been reclassified on the basis of additional water supply. No direct addition to the tax base has been attributed to them, nor was any attempt made to evaluate the indirect additions to the tax base such as increased machinery and equipment, more improvements, and greater numbers of livestock.

   The state income tax base is also broadened as a result of the direct and indirect benefits generated by the project.

7. Total net direct and indirect benefits derived from the project in 1961 were approximately $750,000.00. Assuming the life of the project to be fifty years and the average annual benefits equal to those of 1961, then total benefits for the period would be approximately 37.5 million dollars. In view of past experience with similar projects, the assumed fifty year project life seems highly conservative. If use continues beyond this period, the total benefits will increase accordingly. The determination of such a life period takes into consideration the risk and uncertainty involved.

8. By again assuming fifty year project life and average annual benefits of $750,000.00, the current value of the investment can now be determined. This value depends on the discount or interest rate used. At 4%, the current value would be 16.1 million dollars; at 5%, 13.7 million dollars; and at 6%, 11.8 million dollars. These figures compare very favorably with present construction costs. The total project cost was approximately 1.2 million dollars at the time of construction. In 1961 dollars, this would be approximately 5.4 million dollars. This analysis indicates that the ratio of the present value of net returns to construction costs (benefit/cost ratio) would be approximately 3 to 1 at 4%, 2.5 to 1 at 5%, and 2.2 to 1 at 6%.

9. Every person interviewed, without exception, commented on the great value of the project in stabilizing the local farming and ranching operations. The general attitude toward the Ruby River Project was one of satisfaction and appreciation.

Water Rights

All water for this project has been adjudicated. The Department has the following water rights:

1. On Garden Creek, dated May 15, 1880, for all waters.
2. On a certain Spring & Lake, dated April 26, 1892 for 100 MI.
3. West Fork of the Ruby River, dated September 3, 1928 for 200 MI.
4. Ruby River and tributaries, dated April 8, 1938 for all unappropriated waters.

Measuring Devices

The Department maintains a continuous recording device on the Ruby River. Since the Ruby River is an adjudicated stream, all water is measured out to individual water users by a water commissioner.

Inspection Report

The dam was last inspected in the spring of 1972. The inspection report includes the following notations:

1. Minor patchwork needed on most structures.
2. Riprap needed on the left abutment of the spillway.
3. Channel work needed below outlet.

Another inspection of the dam is planned for the spring of 1973.

Operation and Maintenance

In 1957, extensive riprap was added to the face of the dam. In 1965, repairs were made to the concrete slab on the spillway.

An operation practice that has caused concern is allowing the reservoir to fill up rapidly in the spring, which results in extensive use of the emergency spillway. Water that passes over the spillway is considered to be "free water" and no charge is made for this water.

Engineering Data

DAM:

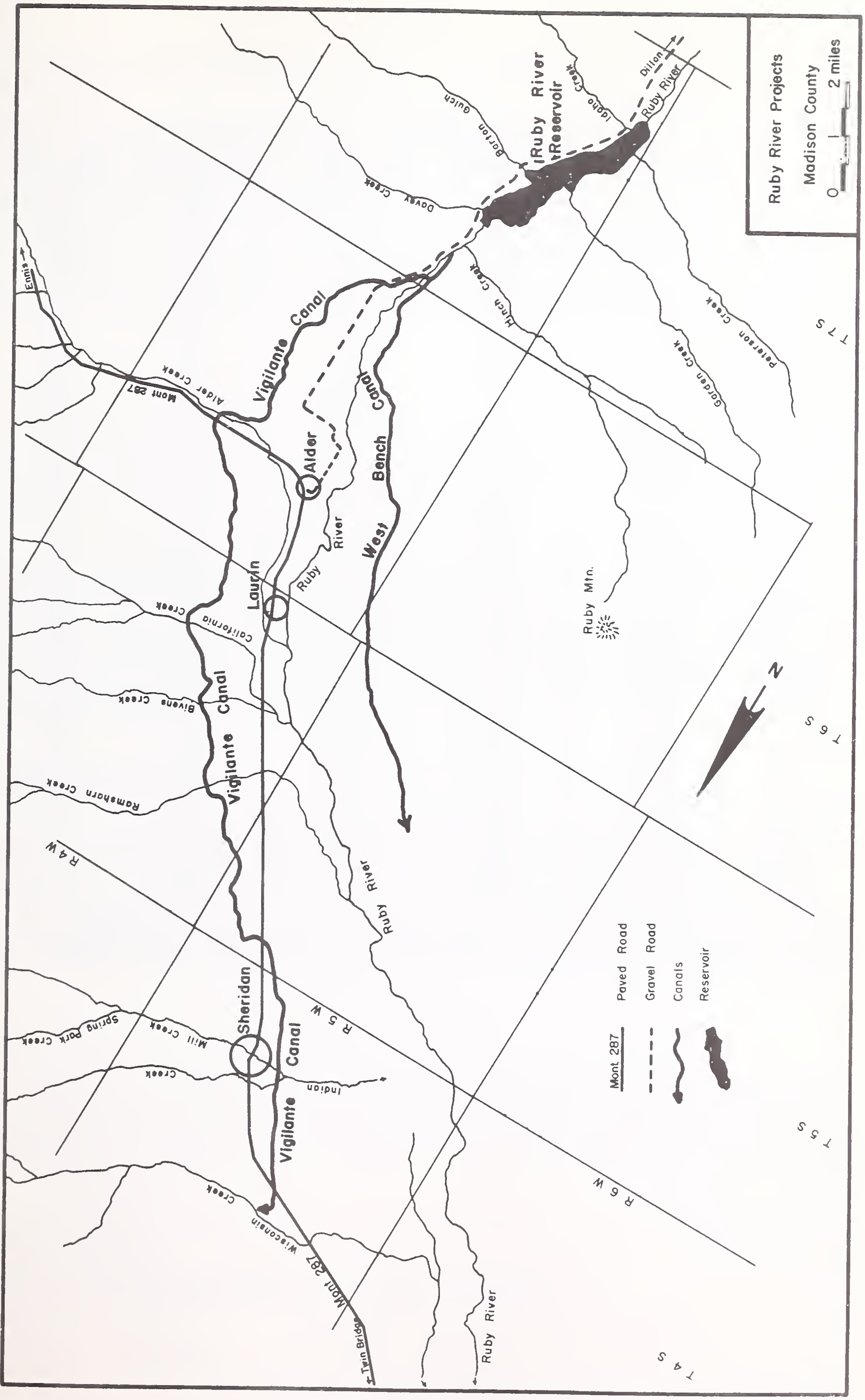
Storage: 38,850 A.F.
Spillway: Width 125'
Capacity 30,000 cfs
Gates: 1 - 72" dia. Slide and 1 - 72" dia. Pivot -- Dry Tower
Height: 111'
Length: 846'

Type: Earth Fill -- 714,394 cu. yds.
Content Measuring Device: Cable Down Face
Initial Cost: $768,019.50

CANALS:

None

R/W Reservoir Pool: 970 Acres Deeded
Reservoir Land: 161.61 Acres Deeded


Ruby River Projects
Madison County
0
1
2 miles
Ruby River Reservoir
Dillon
Ruby River
Idaho Creek
Barton Gulch
Davey Creek
Hinch Creek
Peterson Creek
Garden Creek
T 7 S
Vigilante Canal
Alder Creek
Mont 287
Ennis
Alder
West Bench Canal
Ruby River
Laurin
California Creek
Ruby Mtn.
N
T 6 S
Bivens Creek
Vigilante Canal
Ramshorn Creek
R 4 W
Ruby River
Sheridan
Spring Park Creek
Mill Creek
Indian Creek
Canal
R 5 W
Vigilante Canal
T 5 S
R 6 W
Wisconsin Creek
Mont 287
Twin Bridges
Ruby River
T 4 S
Mont 287
Paved Road
Gravel Road
Canals
Reservoir

NO.78

RUBY RIVER DAM

ELEVATION	ACRE FEET	ELEVATION	ACRE FEET	ELEVATION	ACRE FEET
5392*	38850*	5361	15196	5330	3860
5391	37894	5360	14530	5329	3632
5390	36937	5359	14111	5328	3404
5389	36027	5358	13691	5327	3176
5388	35118	5357	13272	5326	2948
5387	34208	5356	12852	5325	2720
5386	33298	5355	12433	5324	2492
5385	32389	5354	12013	5323	2264
5384	31479	5353	11594	5322	2036
5383	30569	5352	11174	5321	1808
5382	29659	5351	10755	5320	1580
5381	28750	5350	10335	5319	1501
5380	27840	5349	9916	5318	1422
5379	27175	5348	4496	5317	1393
5378	26509	5347	9077	5316	1264
5377	25844	5346	8657	5315	1185
5376	25178	5345	8238	5314	1106
5375	24513	5344	7818	5313	1027
5374	23847	5343	7399	5312	948
5373	23182	5342	6979	5311	869
5372	22516	5341	6560	5310	790
5371	21851	5340	6140	5309	711
5370	21185	5339	5912	5308	632
5369	20520	5338	5684	5307	553
5368	19854	5337	5456	5306	474
5367	19189	5336	5228	5305	395
5366	18523	5335	5000	5304	316
5365	17858	5334	4772	5303	237
5364	17192	5333	4544	5302	158
5363	16527	5332	4316	5301	79
5362	15861	5331	4088	5300	0

* Spillway Crest

Top of Dam Elev. 5407, Max. Spillway Cap. — 30,000 c.f.s. at 15 ft. head, Surcharge Capacity — 15,000 A.F. for total 53,800 A.F.

SIDNEY

Introduction

This project, located near Sidney in Richland County, Montana, consists of three main pumping stations on the Yellowstone River, four relift pumps, and an auxiliary river pump. There are also canals and related structures. The project was originally built in 1939 with a loan and grant from the Public Works Administration and with State Water Conservation Board funds. The project was completely reconstructed in 1971 and 1972 at a cost of about $1,200,000.00, 50% of which was granted through the Public Law 566 program by the Soil Conservation Service. The remainder was financed with loans from the Farmers Home Administration and the Montana Water Resources Board.

Water Purchase Contracts and Finances

There are currently contracts for 13,767 acre feet. Charges for water in 1973 are $1.93 principal and $2.10 O & M, for a total charge of $4.03 per acre foot. The present principal payment which includes payment for the new construction, is $1.48 higher than in previous years.

Book charges do not include the cost of the new construction, since final payments have not been made for the work. The book charge as of June 30, 1972, was $99,307.74. There are water purchase contracts for future water sales in the amount of $31,025.30 and a repayment contract with the Sidney Water Users Association with an outstanding balance of $10,650.00. Therefore, there is a shortage based on current contracts of $57,632.44 under the state investment. This shortage will be resolved when contracts are drawn to pay for the new construction work.

Economic Analysis

In 1968, as a part of the reconstruction proposal, an economic investigation analysis of the project was made by the Soil Conservation Service. Its investigation concentrated primarily on agricultural water management and secondarily on flood prevention. A determination was made that each part of the watershed project was economically feasible. The benefits were found to be of such magnitude that a detailed analysis of cost savings was deemed unnecessary.

Water Rights

On September 1, 1937, the State Water Conservation Board filed a "declaration of intention to store, control and divert" all unappropriated water of the Yellowstone River and its tributaries. On December 15, 1938, an "amendatory declaration" was filed for all unappropriated waters of the Yellowstone River and its tributaries.

Measuring Devices

Parshall Flumes measure the water on this project.

Recent Major Construction

In 1971 and 1972, the project was completely reconstructed. New pump stations were installed, and most of the canal system was rebuilt. Several new canals were built, enabling new land to be brought under the system. There were also two flood control dams constructed to protect the new system. Drains are being built on the project. Other minor work is needed which should be completed in 1973.

Engineering Data

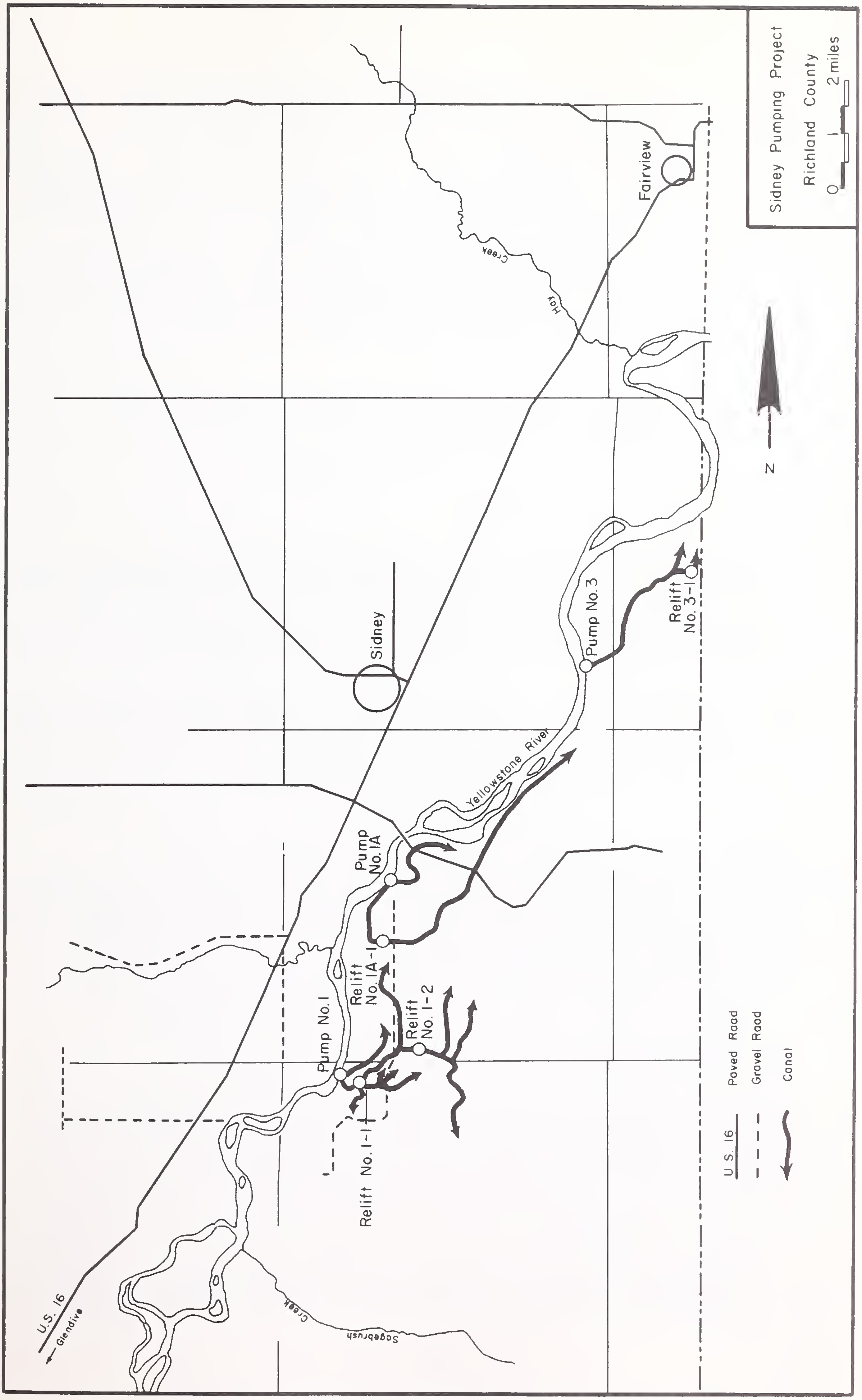
DAM:

None

STORAGE:

Pumped from the Yellowstone River.

		Discharge	Head	Acres
River Pump Site #1	1-100 H.P. Pumps	13.0 cfs	48.3 ft.	460
	3-200 H.P. Pumps	51.12 cfs	79.0 ft.	875
Relift Pump Site #1-1	1- 30 H.P. Pumps	9.0 cfs	70.0 ft.	370
Relift Pump Site #1-2	2-100 H.P. Pumps	20.8 cfs	66.7 ft.	870
River Pump Site #1-A	2- 75 H.P. Pumps	29.1 cfs	75.0 ft.	210
Relift Pump Site 1-A-1	2- 40 H.P. Pumps	22.8 cfs	80.0 ft.	790
River Pump Site #3	2- 75 H.P. Pumps	30.0 cfs	36.5 ft.	1160
Relift Pump Site #3-1	1- 15 H.P. Pumps	6.0 cfs	16.8 ft.	80


Sidney Pumping Project

Richland County

SMITH RIVER

Introduction

This project consists of a dam and storage reservoir about nine miles northeast of White Sulphur Springs in Meagher County, Montana. The reservoir has a capacity of 11,600 acre feet and a surface area of 325 acres when full. Construction of the dam, which was financed with a loan and grant from the Public Works Administration and with State Water Conservation Board funds, was completed in 1936. Recreational use of the reservoir includes camping, boating and picnicking.

Most of the water is taken through private diversions from the river. The South Side Canal, another Department project, obtains its water supply from the North Fork of the Smith River Reservoir.

Water Purchase Contracts and Finances

Members of the Smith River Water Users Association hold water purchase contracts for 11,000 acre feet per year, which is the firm annual yield of the project. The water charges are $.90 for principal and $.25 for O & M, for a total charge of a $1.15 per acre foot. The $.25 O & M charge reflects a 1973 increase of $.15 per acre foot which was effected to meet rising costs and to start a reserve fund.

On June 30, 1972, this project had a book credit of $983.25. There are water purchase contracts for future water sales in the amount of $7,124.50. The state investment will be overrecovered by $8,107.25.

Economic Analysis

Two reports have been written recently, both of which included an analysis of the economic benefits of the Smith River Project. The reports were "An Economic Analysis of Selected Montana State Water Conservation Board Projects", in 1964 by Elroy C. McDermott of Montana State College, and "An Ex Post Economic Evaluation of Montana Water Resources Board Projects", in 1971 by Bill Turnquist, an intern sponsored by the Western Interstate Commission for Higher Education, (WICHE).

Some of the conclusions of the 1964 report were:

1. Livestock ranching became the dominant agricultural activity in Meagher County due to the scarcity of rainfall and short growing season. In order to stabilize these livestock operations, means of greatly increasing the production of winter feed needed to be established. The North Fork of the Smith River Project greatly increased the amount of feed that could be produced, both on acres already being farmed and by bringing additional acres into production. This project serves approximately 11,000 acres of land, consisting of 9,000 supplementary acres and approximately 2,000 acres receiving a primary supply.

2. Meagher County has experienced a relatively favorable level of living during the past three decades compared to the level of living of farm families in the State as a whole and also in the nation. The favorable position of this county can be largely attributed to the balanced livestock program to which the Smith River Project has contributed greatly.

3. Risk and uncertainty have been greatly reduced as a result of this irrigation project. The users report that, had it not been for the project, they would have harvested very little in 1961. Average yield has been approximately doubled on supplementary acres, and in dry years the project means the difference between getting or not getting a crop.

4. The average value of an acre of irrigated land was $124.15 compared to $24.98 for an acre of grazing land of comparable quality and fertility. This difference of approximately $100.00 in value should represent the capitalized value of the net returns of the water discounted over time.

5. The Smith River Project has considerably broadened the tax base of Meagher County. The average assessed value of irrigated lands in the county for 1962 was $21.57 per acre compared to an average of $2.78 per acre of grazing land, making a increase of $18.79 per acre. The addition of 2,000 acres to the irrigated tax rolls would increase the tax base by approximately $37,580.00. It is assumed the 9,000 supplementary acres were previously classified as irrigated land. There are indirect additions to the tax base resulting from the project, such as more machinery and equipment, more improvements, and increased number of livestock. The state income tax is also increased by the direct and indirect benefits produced by the project. No attempt was made in this study to evaluate these effects.

6. In 1962, the total net direct and indirect benefits derived from the project totaled approximately $160,000.00. If a project life of fifty years and an average annual income equal to that of 1951 are assumed, then the total benefits over the life of the project would be approximately $8 million. This assumed project life may seem conservative, but in this figure some allowances are made for risk and uncertainty.

7. By again assuming a fifty year life of the project and an annual benefit of $160,000.00, the current value of the investment can be determined. The discount or interest rate used greatly affects this value. The current value would be $3.4 million at a rate of 4%, $2.9 million at a rate of 5%, and $2.5 million at a rate of 6%. Total cost of the project at the time of construction, 1936, was approximately $1.4 million. The present value of net returns compares very favorably with the present value of construction costs. This ratio (benefit/cost ratio) would be approximately 2.4 to 1 at 4%, 2 to 1 at 5%, and 1.8 to 1 at 6%.

8. The local attitude toward the Smith River Project is one of satisfaction and commendation. Farmers, ranchers and merchants all attested to the great worth of the project in increasing and stabilizing the economy of the area.

In the 1971 report, "An Ex Post Economic Evaluation of Montana Water Resources Board Projects" a sensitivity analysis was made to determine the probable range of economic benefits which resulted from the project. The analysis was based on a detailed economic study of the project. Two ranges of benefits were used. The lower range assumes the project increased crop values on project lands by 10%. The higher range assumes a 50% increase. Several different interest rates are used to bring the cost and benefits to current valuation. The following table gives the results.

The Range of Benefit/Cost Ratios with Sensitivity Analysis, Based on Ex Post Analysis from 1936-1970, North Fork of Smith River and Southside Canal Projects.

	i = 2%	i = 5%	i = 8%
LOWER ASSUMED BENEFITS	2.44	1.41	0.89
HIGHER ASSUMED BENEFITS	8.30	4.81	3.04

The preceding figures do not include secondary or extra-market cost or benefits, which include effects on general economic conditions, on the environment, and on community attitudes and stability. Benefits include a reduction in the risk and uncertainty associated with crop production. There is also a better hay supply, eliminating the need to truck hay into the area in winter. Community attitudes in the area towards the project seems to be very favorable.

Water Rights

On October 20, 1935, a water right was filed by the State Water Conservation Board on the North Fork of the Smith River for all unappropriated water.

Measuring Devices

The Department maintains a continuous recorder on the Smith River below the dam. A water commissioner measures the water to all users.

Inspection Report

The dam was inspected on July 7, 1971. The inspection report included the following notation:

1. Minor repairs are needed on the inlet, outlet and apron of the spillway.
2. Some riprap is needed at the weir.
3. There are minor cracks & spalling on the spillway and weir.

Another inspection is scheduled during the spring of 1973.

Operation and Maintenance

Over the past several years occasional repairs have been made to the riprap on the face of the dam and to the spillway.

At this time no major repairs are planned for the future.

Engineering Data

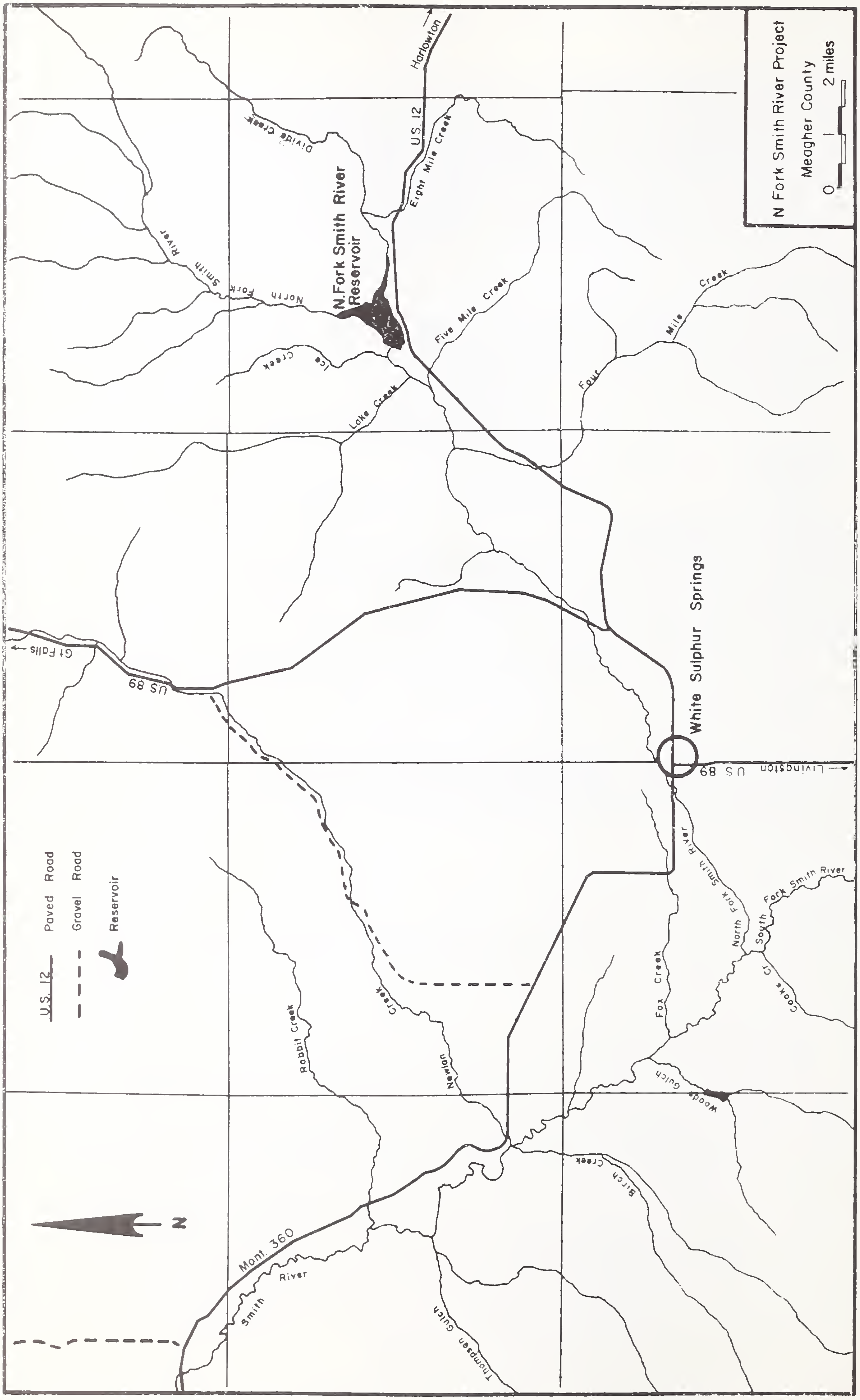
DAM:

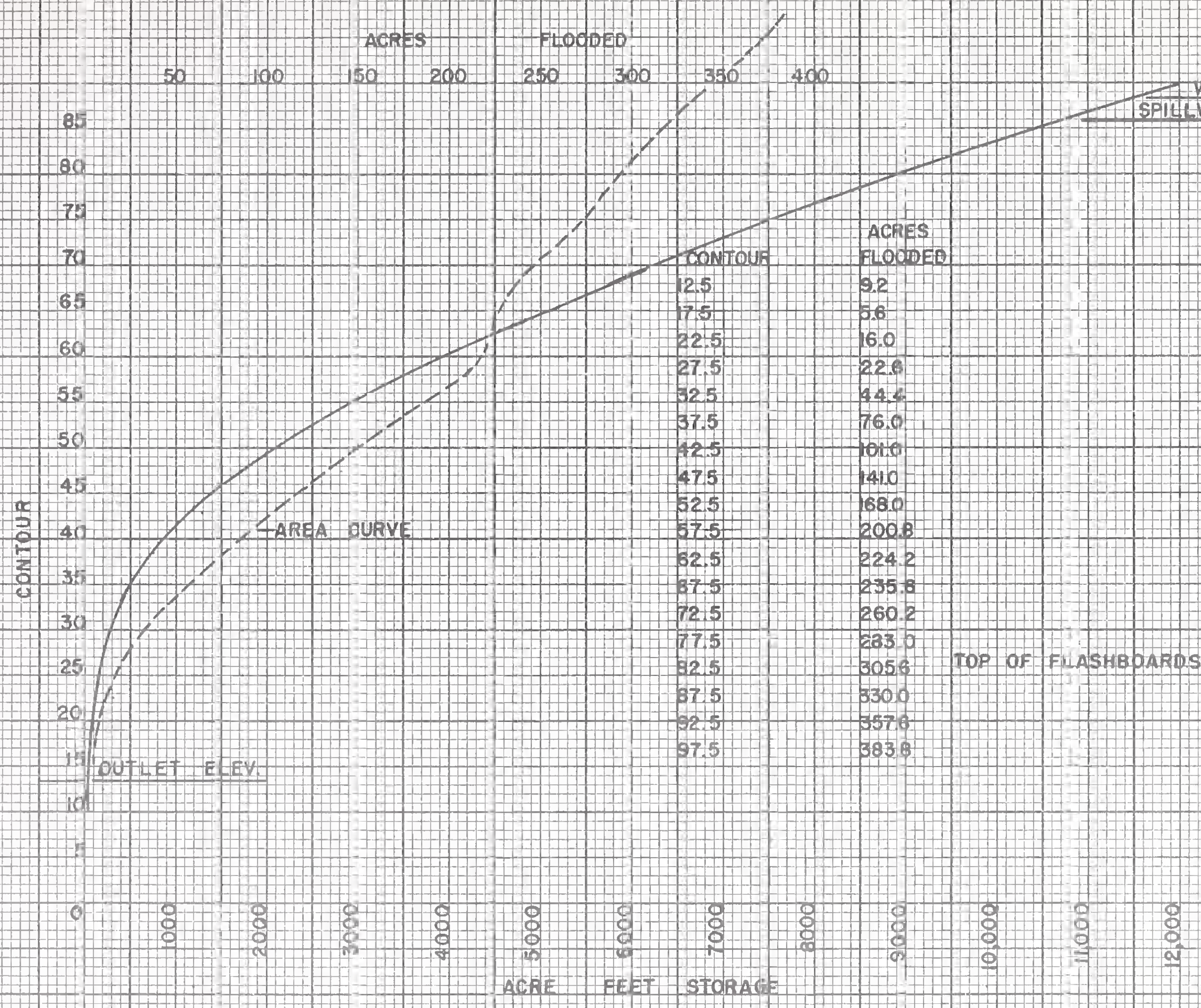
Storage: 11,600 A.F.
Spillway: Width 80'
Capacity 4,000 cfs
Gates: 1 - 54" dia. Slide and 1 - 54" Pivot -- Dry Tower
Height: 86'
Length: 1,223'
Type: Earth Fill -- 391,000 cu. yds.
Content Measuring Device: Elevation Pins down face
Initial Cost: $310,414.71

CANALS:

None

R/W Reservoir Pool: 335 Acres Deeded and Easement
Reservoir Land: 189.95 Acres Deeded and Easement


N Fork Smith River Project
Meagher County
0
1
2 miles
U.S. 12
Paved Road
Gravel Road
Reservoir
N
N.Fork Smith River Reservoir
White Sulphur Springs
Harlowton
US 12
Gt Falls
US 89
US 89
Livingston
Mont. 360
Divide Creek
North Fork Smith River
Eight Mile Creek
Five Mile Creek
Four Mile Creek
Ice Creek
Lake Creek
North Fork Smith River
South Fork Smith River
Cooks Cr
Fox Creek
Woods Gulch
Birch Creek
Rabbit Creek
Newlan Creek
Thompson Gulch
Smith River



CONTOUR	ACRES FLOODED
12.5	9.2
17.5	5.6
22.5	16.0
27.5	22.6
32.5	44.4
37.5	76.0
42.5	101.0
47.5	141.0
52.5	168.0
57.5	200.8
62.5	224.2
67.5	235.8
72.5	260.2
77.5	283.0
82.5	305.6
87.5	330.0
92.5	357.6
97.5	383.8

	CONTOUR	AC. FT. STORAGE
	10	6
	15	52
	20	80
	25	160
	30	273
	35	495
	40	875
	45	1380
	50	2085
	55	2925
	60	3929
	65	5050
	70	6228
	75	7529
	80	8944
	85	10,472
	86	10,750
TOP OF FLASHBOARDS –	88.5	11,600
	90	12,122
	95	13,910
	100	15,829

NORTH FORK SMITH RIVER RESERVOIR

STORAGE CURVE

MEAGHER COUNTY PROJECT NO. 82

SOUTH SIDE CANAL

Introduction

This project diverts water from the North Fork of the Smith River. The water supply is from the Smith River Reservoir. The canal, with a capacity of 60 cfs, is about thirteen miles long and is located to the east of White Sulphur Springs in Meagher County, Montana. Construction, which was financed with State Water Conservation Board funds, was completed in 1950.

Water Purchase Contracts and Finances

There are water purchase contracts for 3,750 acre feet per year. Charges for water are $.20 for principal and $.30 for O & M, for a total charge of $.50 per acre foot. The O & M charge does not cover all O & M expenses, and the South Side Canal Users Association assesses each water user periodically for repairs. The water users also pay Smith River project principal and O & M charges.

The book charge on June 30, 1972, was $31,757.02. Water purchase contracts for future water sales total $21,705.00 and there is a repayment contract with the Association with an outstanding balance of $213.65. The state investment in this project which is not secured by current contracts amounts to $9,838.37.

Water Rights

The water for this project is supplied by the Smith River project, and water rights are explained in the Smith River section.

Measuring Devices

Individual turnouts have weirs which are used for measuring.

Operation and Maintenance

In 1962, most of the canal was lined with bentonite, and three bridges were constructed. This is the only major maintenance that has been done on the project, and there are no future major repairs planned.

Engineering Data

DAM:

Direct Diversion

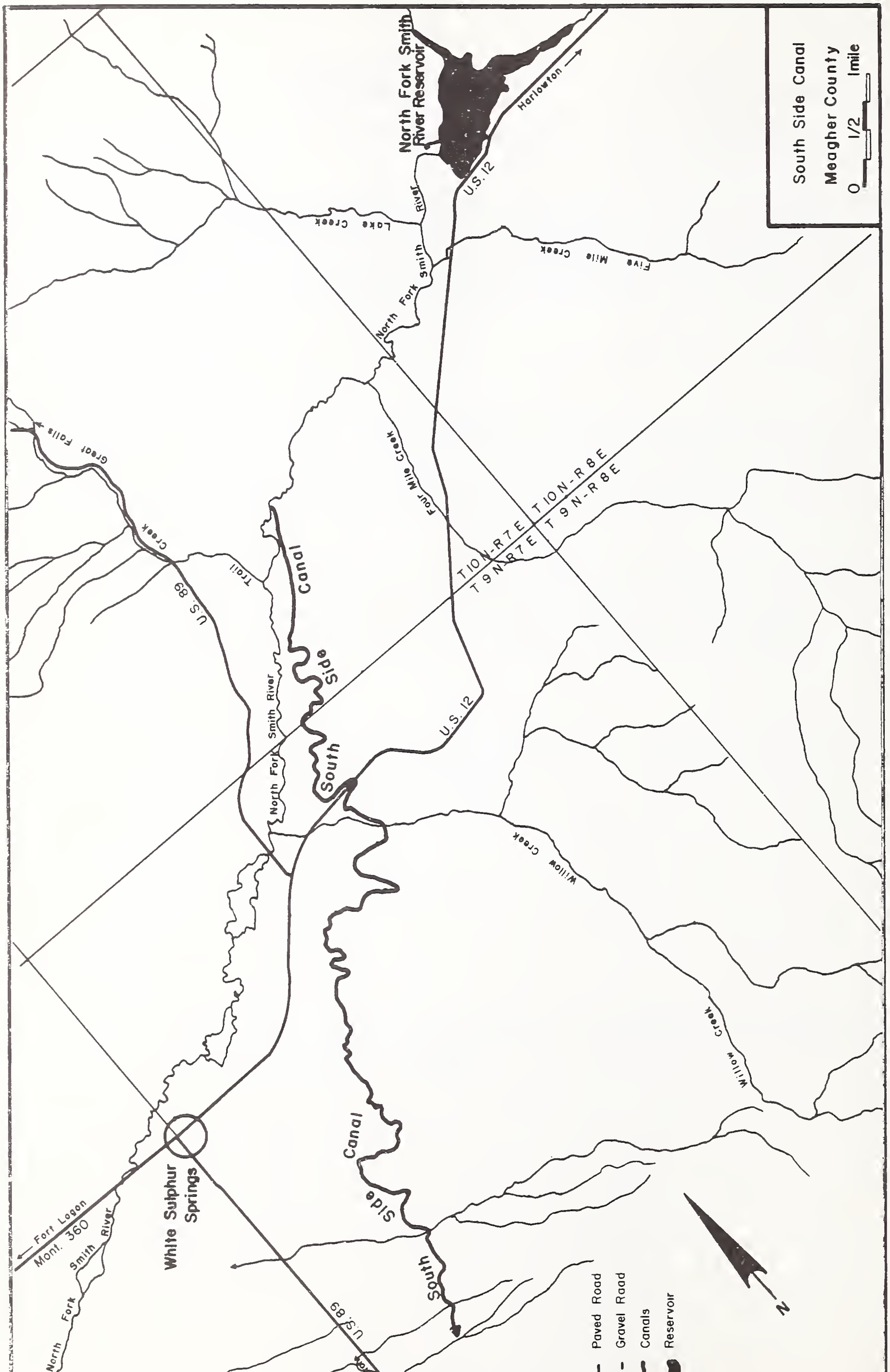
CANAL:

12.5 miles
Capacity 60 cfs
2 - 30" dia. Slide Gates

Measuring Device: Water Stage Recorder

Initial Cost: $41,327.92

R/W Canal 66.19+ Acres Deeded Partially


South Side Canal
Meagher County
0
1/2
1mile
North Fork Smith River Reservoir
Harlowton
U.S. 12
Lake Creek
North Fork Smith River
Five Mile Creek
Great Falls
Trail Creek
U.S. 89
Four Mile Creek
T10N-R7E
T10N-R8E
T9N-R7E
T9N-R8E
South Side Canal
North Fork Smith River
U.S. 12
Willow Creek
Willow Creek
South Side Canal
White Sulphur Springs
Fort Logan
Mont. 360
North Fork Smith River
U.S. 89
Livingston
N
U.S. 12 Paved Road
Gravel Road
Canals
Reservoir

TONGUE RIVER

Introduction

The Tongue River Project is a dam and storage reservoir about ten miles north of the Montana-Wyoming state line near Decker in Big Horn County, Montana. The reservoir has a capacity of 69,439 acre feet and floods an area of 3,497 acres when full. In addition to its agricultural benefits, the reservoir also receives considerable recreational use, and water has been sold for industrial purposes. Construction of the project, which was financed with a loan and grant from the Public Works Administration and with State Water Conservation Board funds, was completed in 1940.

Water Purchase Contracts and Finances

Current contracts for agricultural use of water involve 35,835 acre feet per year, and there is an option on 4,175 acre feet of water for industrial use. The estimated firm annual yield on this project is 40,000 acre feet. Therefore, no more water is available.

The agricultural water users pay $1.30 principal and $.28 O&M, making a total charge of $1.58 per acre foot. The O&M has decreased over the past five years due to a large number of new contracts. The Tongue River Water Users' Association operates the dam only. All of the users divert their water with private diversions from the Tongue River.

The book charge as of June 30, 1972, was $103,423.57. There are water purchase contracts for future water sales in the amount of $916,284.03. The State investment will be overrecovered by $812,860.46 with the agricultural contracts, and additional money will be recovered through an industrial water sale contract. This agreement will return $9,393.75 per year until the option is exercised, and, at that time, the contract will yield to a maximum of $104,375.00 per year. A term of the option agreement is that the development of the water must begin within five years and that the project must be completed within ten years.

Water Rights

A water right was filed by the State Water Conservation Board in Rosebud County on April 19, 1937, for all unappropriated water of the Tongue River. The Board filed another water right in Big Horn County on January 31, 1938, for all unappropriated water of the Tongue River. Since Tongue River flows through Wyoming as well as Montana, it is covered by the Yellowstone Compact.

Measuring Devices

The Department maintains three continuous recorders on Tongue River. There are no measuring devices at the individual turnouts.

Recent Major Repairs

In 1965, the dam was grouted in an attempt to control excessive seepage. Sheet piling was driven across the front of the spillway. In 1970, some major repairs were made on control gates. A portion of the spillway floor has also been replaced.

Future Repairs or Plans

In 1968, a comprehensive engineering study was made of the project by Bechtel Corporation, an engineering firm of San Francisco. The purpose of this study which was contracted by the Department was to obtain recommendations for additional development of the Tongue River. Bechtel's proposals included increasing the height of the present dam or building a new dam downstream from the present structure. The new dam appears to be the more feasible. The additional water would initially be used for the potential coal development in the area.

The present dam is being carefully operated to avoid the necessity of using the spillway. There is a considerable amount of spalling around the outlet of the conduit through the dam, and a large part of the floor of the spillway may need to be replaced. Also, the stability of the foundation for the spillway is questionable. A detailed inspection is planned for the Spring of 1973.

Engineering Data

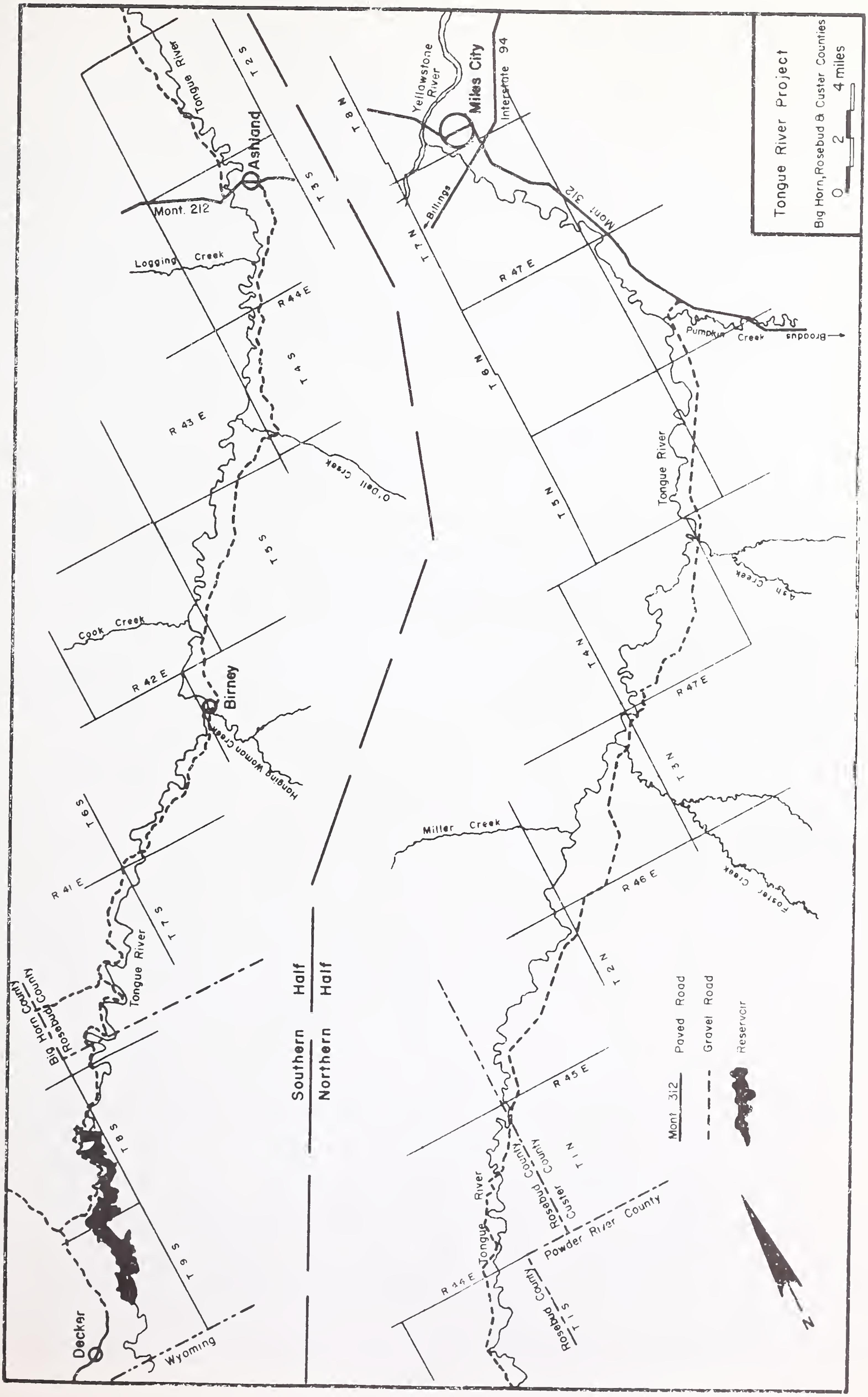
DAM:

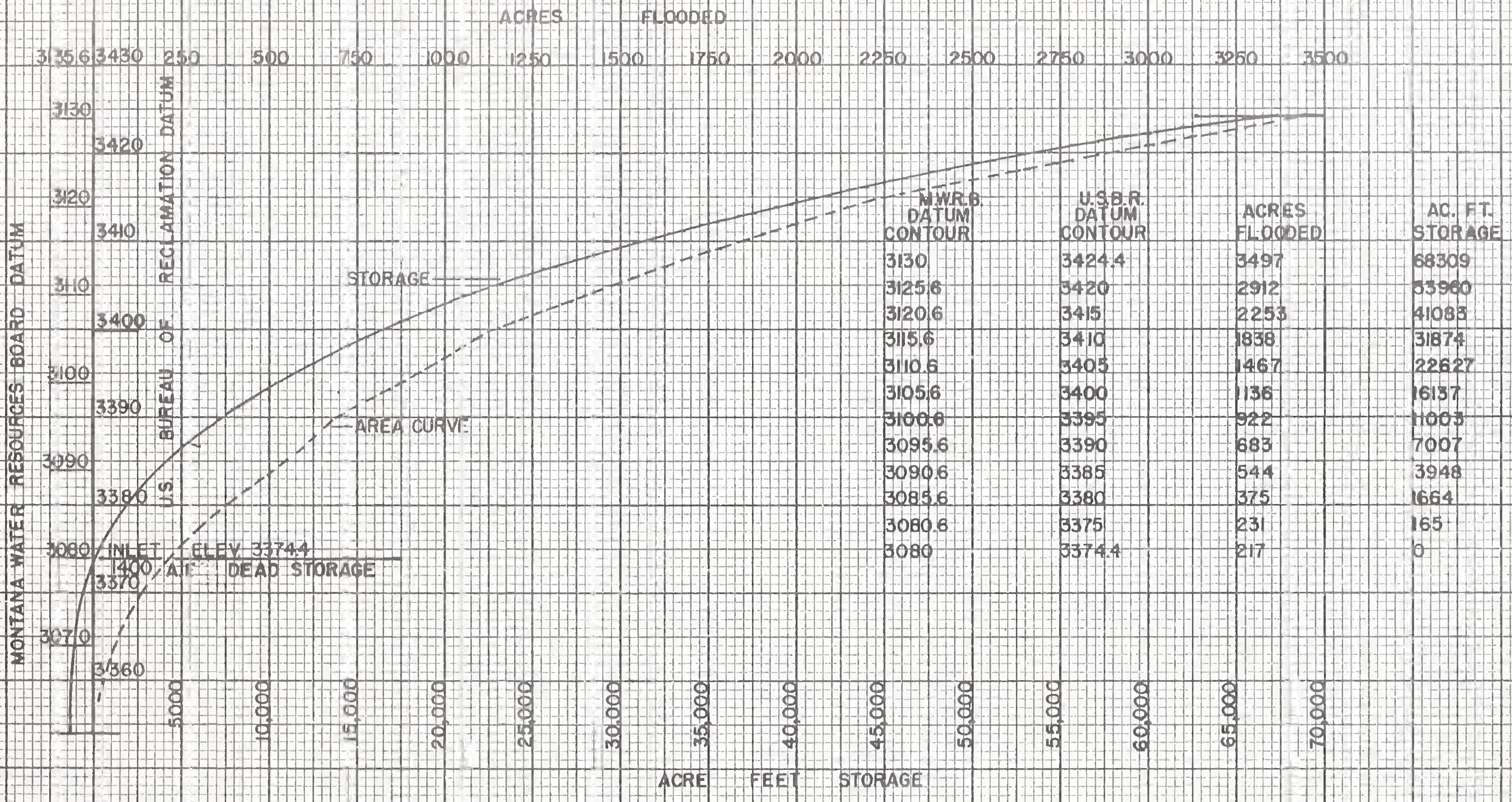
Storage: 69,439 A.F.
Spillway: Width 350'
Capacity 60,000 cfs
Gates: 2 - 6' x 12' Slide -- Wet Tower
Height: 91'
Length: 1.824'
Type: Earth Fill -- 1,225,000 cubic yards
Content Measuring Device: Cable Down Face
Initial Cost: $1,524,474.92

CANALS:

None

R/W Reservoir Pool: 3,497 Acres Deeded
Reservoir Land: 2,326.35 Acres Deeded


Tongue River Project
Big Horn, Rosebud & Custer Counties
0 2 4 miles
Miles City
Yellowstone River
Interstate 94
Billings
Mont 312
Broadus
Pumpkin Creek
Tongue River
Ash Creek
Foster Creek
Miller Creek
T 8 N
T 7 N
T 5 N
T 4 N
T 3 N
T 2 N
T 1 N
T 1 S
R 47 E
R 46 E
R 45 E
R 44 E
Rosebud County
Custer County
Powder River County
Mont 312 Paved Road
Gravel Road
Reservoir
N
Southern Half
Northern Half
Tongue River
Ashland
Mont. 212
Logging Creek
O'Dell Creek
Cook Creek
Birney
Hanging Woman Creek
T 2 S
T 3 S
T 4 S
T 5 S
T 6 S
T 7 S
T 8 S
T 9 S
R 44 E
R 43 E
R 42 E
R 41 E
Big Horn County
Rosebud County
Decker
Wyoming



M.W.R.B. DATUM CONTOUR	U.S.B.R. DATUM CONTOUR	ACRES FLOODED	AC. FT. STORAGE
3130	3424.4	3497	68309
3125.6	3420	2912	53960
3120.6	3415	2253	41083
3115.6	3410	1838	31874
3110.6	3405	1467	22627
3105.6	3400	1136	16137
3100.6	3395	922	11003
3095.6	3390	683	7007
3090.6	3385	544	3948
3085.6	3380	375	1664
3080.6	3375	231	165
3080	3374.4	217	0

TONGUE RIVER RESERVOIR

STORAGE CURVE

BIG HORN COUNTY PROJECT NO. 29

UPPER MUSSELSHELL

Introduction

This project consists of three dams, two storage reservoirs, with a total capacity of 30,134 acre feet, and fifty-two miles of canals. Bair Reservoir is located in Meagher County, Montana, about one-half mile west of Delpine, and Martinsdale Reservoir, an offstream storage reservoir, is located one mile southeast of Martinsdale in Meagher and Wheatland Counties. Two dams were necessary at the Martinsdale site. The project, which was financed by a loan and grant from the Public Works Administration supplemented by State Water Conservation Board funds, was completed in 1939. Both reservoirs receive recreational use.

Water Purchase Contracts and Finances

Fifty members of the Upper Musselshell Water Users' Association hold 73 contracts for 14,946 acre feet per year on this project. Construction charges are $1.10 per acre foot and O&M charges are $.90 per acre foot, making a total charge of $2.00 per acre foot.

Book charges for the project as of June 30, 1972 totaled $114,665.13. Expected revenue from present water purchase contracts is $123,145.00 which will result in an overrepayment of the state investment in the amount of $8,479.87. A small reserve fund has been established. There is a potential for additional water sales.

Water Rights

In 1937, the State Water Conservation Board filed a water right for all unappropriated waters of the North Fork of the Musselshell and all tributaries.

Measuring Devices

There are thirty-eight turnouts on the project and private diversions out of the river. Twenty-four of the turnouts have meter gates.

Inspection Report

A December 6, 1972, inspection report includes the following observations on the Bair and Martinsdale dams.

BAIR RESERVOIR

1. Riprap repairs are needed on the upstream face of the dam.
2. Large rocks at the outlet tunnel should be removed.
3. Minor patching is needed on the spillway.
4. A safety railing should be installed around the spillway.

5. The stilling basin should be patched.

6. The jet sump is not operating properly.

7. The deflector of the pivot valve is pitted.

MARTINSDALE RESERVOIR - SOUTH DAM

1. A tree should be removed from the upstream face of the dam.

MARTINSDALE RESERVOIR - NORTH DAM

1. There is excessive seepage through the dam.

2. The sump pump is not working properly.

3. The pedestal lift on the floor is loose.

4. The hinge on the grating gate is broken.

5. Willows should be removed at the outlet.

Recent Major Repairs

In 1962, several repairs were made. Some of the canals were cleaned and repaired, and a drop structure was repaired. New riprap was added to one of the Martinsdale dams, its outlet was repaired, and the dam was grouted.

In 1967, riprap was added to the Martinsdale Reservoir, and the Bair spillway was repaired.

Future Repairs or Plans

A canal on the south side of the Musselshell River has been suggested several times. Beginning at the Martinsdale Reservoir, it would be ten to fifteen miles long and would allow the irrigation of about 5,000 acres which may utilize all the water available for sale on the project. There was renewed interest in the proposed canal at the 1972 annual meeting of the water users association. The water users intend to request assistance from the Soil Conservation Service.

Engineering Data

DAM: Bair

Storage: 7,029 A.F.
Spillway: Width 65'
Capacity 6,000 cfs
Gates: 1 - 48" diameter Slide and 1 - 48" diameter Pivot,Dry Tower
Height: 100'
Length: 538'

Type: Earth Fill -- 241,600 cubic yards
Content Measuring Device: Cable Down Face

DAM: Martinsdale

Storage: 23,105 A.F.
Spillway: Width 10'
Capacity 600 cfs
Gates: 1 - 54" diameter Slide and 1 - 54" diameter Pivot
Dry Tower
Height: 96' (North) 49' (East)
Length: 1,000' (North) 1.635' (East)
Type: Earth Fill -- 716,500 cubic yards
Content Measuring Device: Elevation Pins down Face
Initial Cost: $1,034,736.63

CANALS:

Checkerboard: 2.9 miles
Capacity 38 cfs
Measuring Device: None

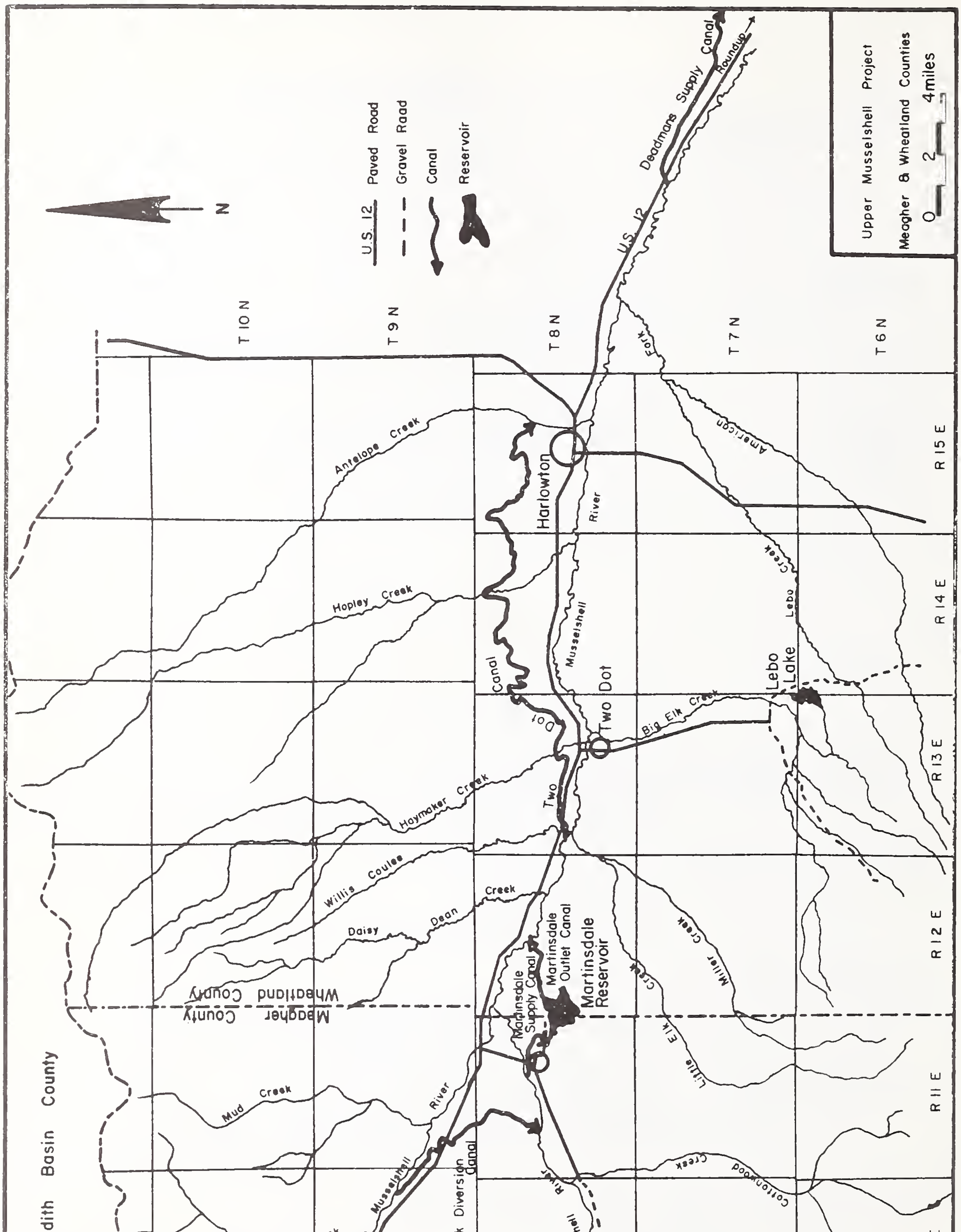
N. Fork Diversion: 11.7 miles
Capacity 105 cfs
Measuring Device: Water Stage Recorder

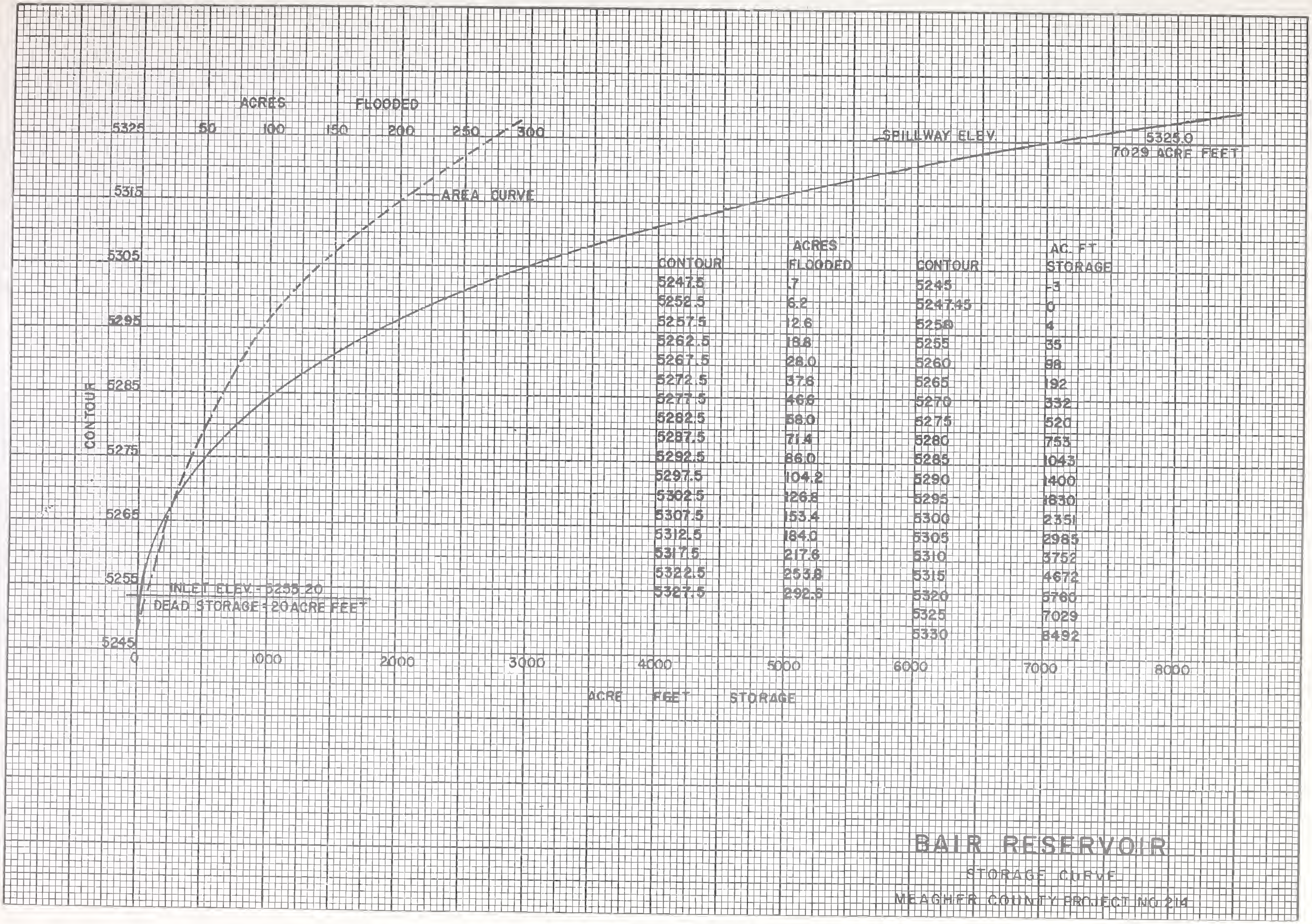
Martinsdale Supply: 2.41 miles
Capacity 408 cfs
Measuring Deivce: Water Stage Recorder

Martinsdale Outlet: 2.57 miles
Capacity 333 cfs
Measuring Device: Water Stage Recorder

Two Dot Canal: 32.12 miles
Capacity 122 cfs
Measuring Device: Water Stage Recorder

R/W Bair Reservoir Pool: 292 Acres Deeded
Bair Reservoir Land: 135.72 Acres Deeded
Martinsdale Reservoir Pool: 1,050 Acres Deeded
Martinsdale Reservoir Land: 349.54 Acres Deeded
Checkerboard Canal: 32.76 Acres Deeded
N. Fork Diversion Canal: 97.74 Acres Deeded
Martinsdale Supply Canal: 37.40 Acres Deeded
Martinsdale Outlet Canal: 26.85 Acres Deeded
Two Dot Canal: 296.10 Acres Deeded


Upper Musselshell Project
Meagher & Wheatland Counties
0 2 4 miles
N
U.S. 12 Paved Road
Gravel Road
Canal
Reservoir
T 10 N
T 9 N
T 8 N
T 7 N
T 6 N
R 9 E
R 10 E
R 11 E
R 12 E
R 13 E
R 14 E
R 15 E
Judith Basin County
Meagher County
Wheatland County
Harlowton
Two Dot
Lebo Lake
Martinsdale Reservoir
Bair Reservoir
Martinsdale Supply Canal
Martinsdale Outlet Canal
Two Dot Canal
Deadmans Supply Canal
North Fork Diversion Canal
Musselshell River
North Fork Musselshell
South Fork Musselshell River
American Fork
Antelope Creek
Hopley Creek
Haymaker Creek
Willis Coulee
Daisy Dean Creek
Mud Creek
Spring Creek
Bonanza Creek
Big Elk Creek
Little Elk Creek
Miller Creek
Lebo Creek
Cottonwood Creek
U.S. 12
White Sulphur Springs
Roundup



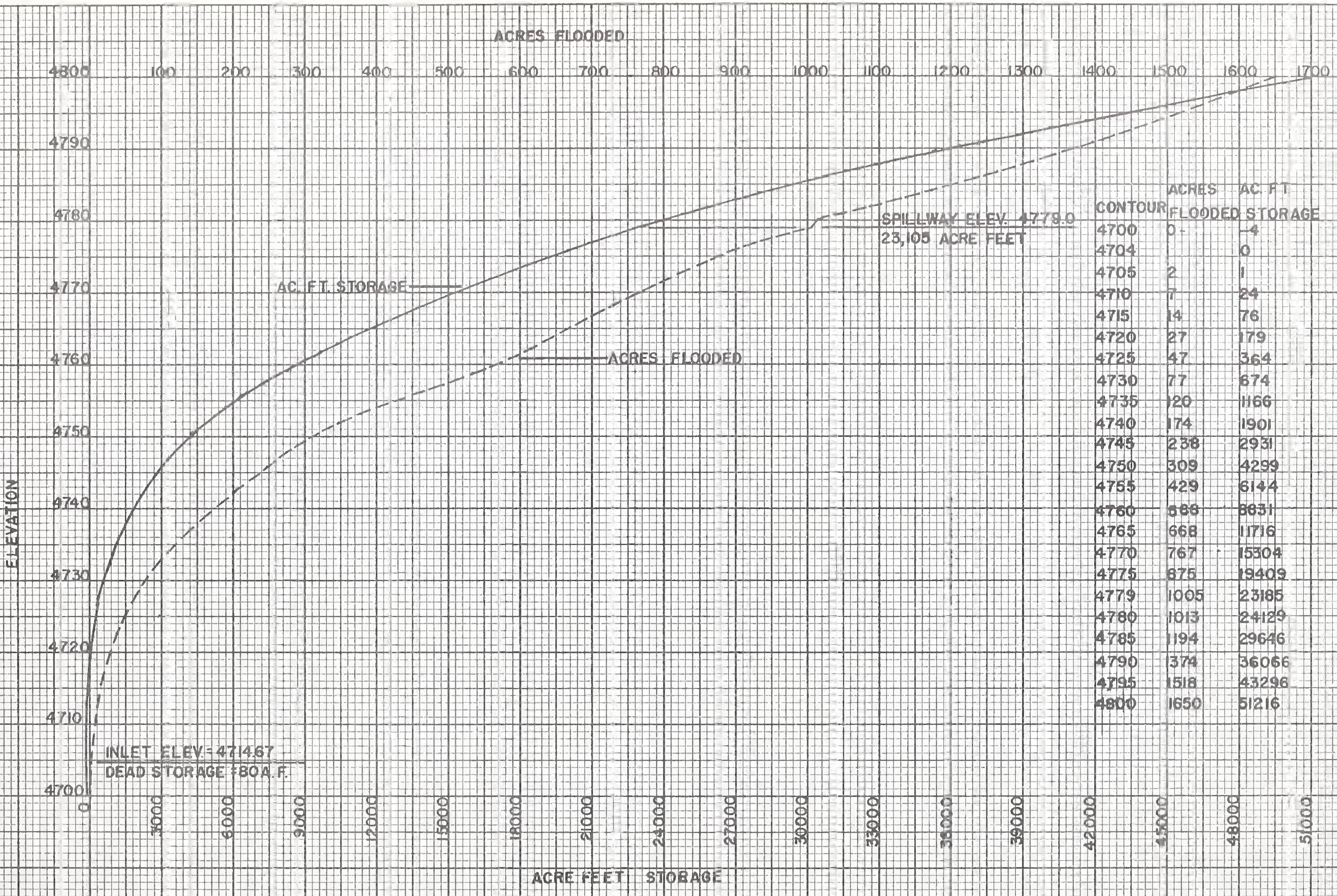
CONTOUR	ACRES FLOODED
5247.5	.7
5252.5	6.2
5257.5	12.6
5262.5	18.8
5267.5	28.0
5272.5	37.6
5277.5	46.6
5282.5	58.0
5287.5	71.4
5292.5	86.0
5297.5	104.2
5302.5	126.8
5307.5	153.4
5312.5	184.0
5317.5	217.6
5322.5	253.8
5327.5	292.6

CONTOUR	AC. FT. STORAGE
5245	-3
5247.45	0
5250	4
5255	35
5260	98
5265	192
5270	332
5275	520
5280	753
5285	1043
5290	1400
5295	1830
5300	2351
5305	2985
5310	3752
5315	4672
5320	5760
5325	7029
5330	8492

BAIR RESERVOIR

STORAGE CURVE

MEAGHER COUNTY PROJECT NO. 214



CONTOUR	ACRES FLOODED	AC. FT. STORAGE
4700	0 -	-4
4704		0
4705	2	1
4710	7	24
4715	14	76
4720	27	179
4725	47	364
4730	77	674
4735	120	1166
4740	174	1901
4745	238	2931
4750	309	4299
4755	429	6144
4760	566	8631
4765	668	11716
4770	767	15304
4775	875	19409
4779	1005	23185
4780	1013	24129
4785	1194	29646
4790	1374	36066
4795	1518	43296
4800	1650	51216

MARTINSDALE RESERVOIR

STORAGE CURVE

WHEATLAND & MEAGHER COUNTIES PROJECT NO. 214

VIGILANTE CANAL

Introduction

This project in Madison County, Montana, diverts water from the Ruby River through a twenty-six mile canal. The water supply for this canal, with a capacity of 115 cfs, comes from the Ruby Reservoir, another Department project. The first mile of the canal is shared with the West Bench Canal. Construction of this project, which was financed by the State Water Conservation Board, was completed in 1956.

Water Purchase Contracts and Finances

There are water purchase contracts for 12,740 acre feet. The current charges for water are $.50 for principal and $.70 for O&M, for a total charge of $1.20 per acre foot. The Vigilante Water Users Association has no reserve fund. The users also pay Ruby River Project Principal and O & M charges.

Book charge as of June 30, 1972, was $266,862.27. There are water purchase contracts for future water sales in the amount of $131,328.00. Based on current contracts there is an unsecured state investment on this project of $135,534.27.

Water Rights

The water for this project is supplied from the Ruby Reservoir, and water rights are hereinbefore explained under the Ruby River Project.

Water Measuring Devices

The Department maintains a continuous recorder at the beginning of the Vigilante Canal. The individual turnouts are measured with meter gates.

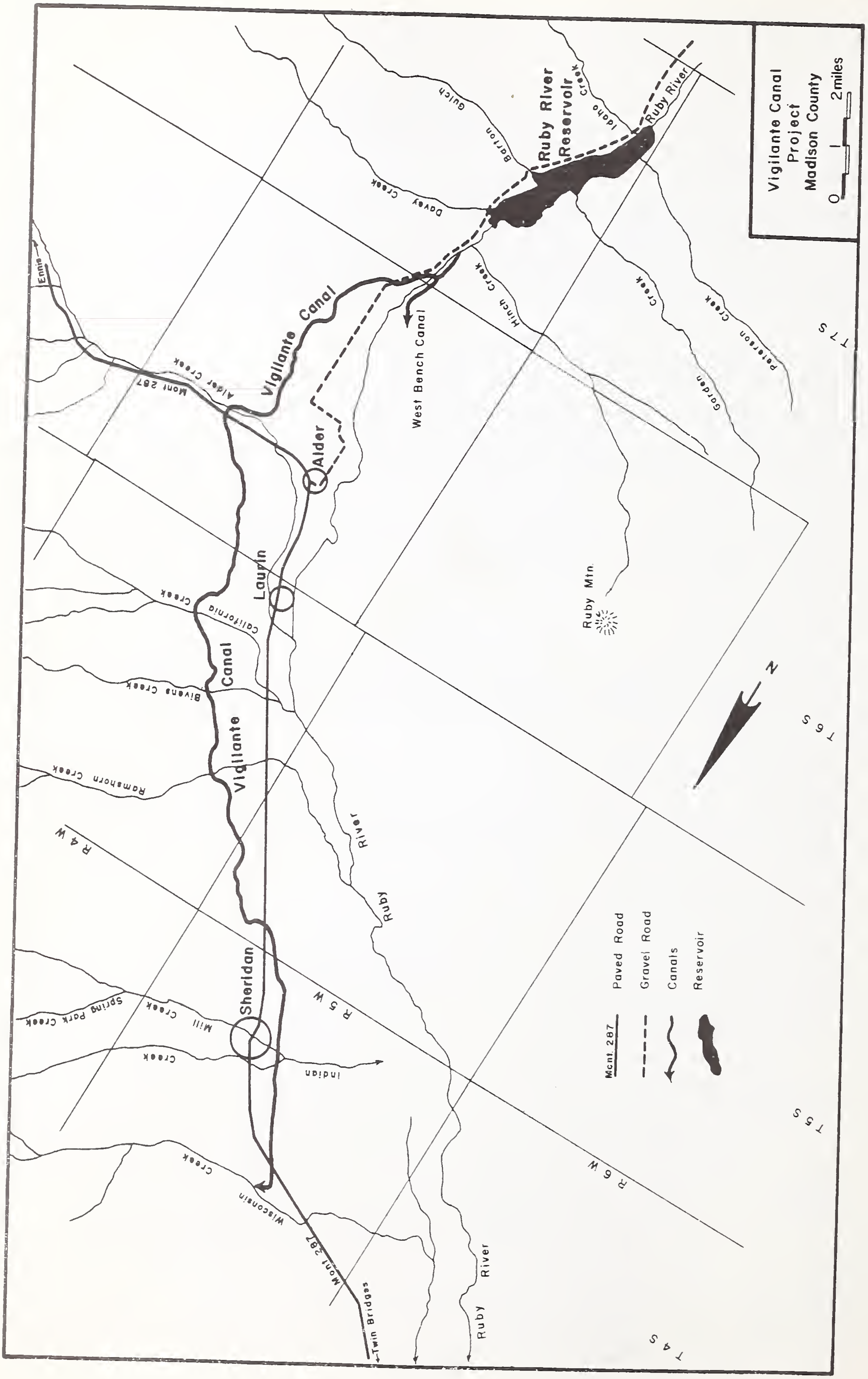
Operation and Maintenance

This project has had very few maintenance problems in the past, and no major repairs are planned for the future. The main maintenance problem seems to be replacing bridges across the canal. A portion of the canal was lined with bentonite in the early 1960's.

Engineering Data:

DAM:	Direct Diversion
CANAL:	25.0 miles Capacity 115 cfs Measuring Device: Water Stage Recorder
R/W	
Canal:	263.54+ Acres Deeded Partially

NOTE: Head end of Canal R/W is added into R/W for West Bench Canal #625W


Vigilante Canal
Project
Madison County
0
1
2miles
N
Mont. 287
Paved Road
Gravel Road
Canals
Reservoir
Ruby River Reservoir
Ruby River
Idaho Creek
Barton Gulch
Davey Creek
Ennis
Vigilante Canal
West Bench Canal
Hinch Creek
Gordon Creek
Peterson Creek
Mont 287
Alder Creek
Alder
Laurin
California Creek
Bivens Creek
Ramshorn Creek
Ruby River
Ruby Mtn.
Sheridan
Mill Creek
Spring Park Creek
Indian Creek
Wisconsin Creek
Mont 287
Twin Bridges
Ruby River
R 4 W
R 5 W
R 6 W
T 4 S
T 5 S
T 6 S
T 7 S

WARHORSE

Introduction

Warhorse Lake, which is located to the northwest of Winnett in Petroleum County, Montana, is an offstream storage reservoir with a capacity of 19,250 acre feet. The project also consists of a four mile diversion canal from Fords Creek, a twenty-six mile distribution canal, a two mile diversion canal from Buffalo Creek, and an additional small reservoir known as Little Bear Lake. Maintenance on the distribution canal became excessive, and that portion of the project was finally abandoned. Although there are now only two users of project water, there is considerable local interest in repairing the project and using the stored water. The lake experiences considerable recreational use and is a National Wildlife Refuge. Construction was financed with federal funds and State Water Conservation Board funds and was completed in 1938.

Water Purchase Contracts and Finances

One of the water users has a paid up contract, and the other buys water on a year-to-year basis. The project has no Operation and Maintenance charge; the two users operate the project themselves.

The book charge on June 30, 1973, was $2,603.06. None of this amount is secured by current contracts. However, it may be recovered if the project is re-developed.

Water Rights

A water right was filed on Duck Creek on November 16, 1909, for 200 miners' inches. On Ford Creek, one water right was filed on August 8, 1911, for 20,000 MI, and another was filed on August 18, 1911, for 10,000 MI. A water right was filed on a certain Dry Creek on December 30, 1911, for 2,500 MI and a water right was filed on Buffalo Creek on August 9, 1914, for 20,000 MI. Finally, a water right was filed on Ford Creek and tributaries on August 20, 1935, for all unappropriated waters. The Department now holds all of these rights.

Measuring Devices

The project has no measuring devices.

Future Repairs or Plans

A major hindrance to future agricultural development of project water is the inadequate water supply. It has been estimated that the evaporation from the Warhorse Reservoir exceeds the average annual runoff available to fill the lake. The only potential for agricultural water sales, then, would be for the very limited quantity which would be available only during high runoff years. Probably less than 1,000 acres could be developed, and water could be supplied approximately five to seven years out of ten.

Additional sources of water have been sought. A diversion from McDonald Creek was considered, but the cost was judged prohibitive. There may be a possibility of using wells to supply the reservoir. However, developing these wells may also prove to be too expensive.

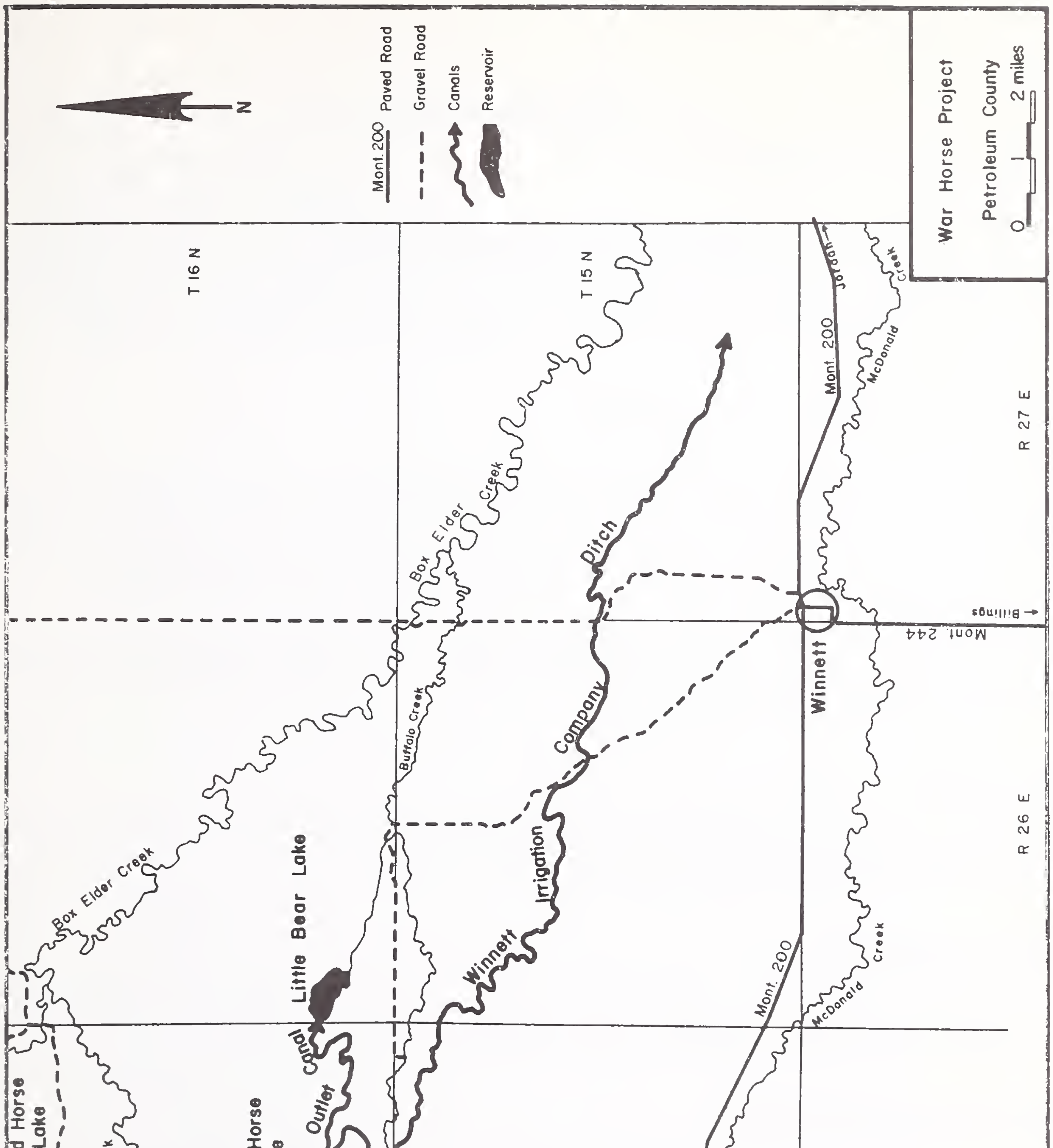
A soil survey was made of the area by the Department in 1972. The several parcels of land suitable for irrigation constituted more land than could be served with the limited water supply of this project.

The Bureau of Sport Fisheries and Wildlife has indicated an interest in using the two lakes for a wildlife habitat. The lakes are now heavily used by migrating birds.

Some repairs will be required in order to insure the safety of the lake. The gates on the diversion structure are inoperable, and the conduit through the dam, which often becomes plugged, may need extensive repairs. The Soil Conservation Service is cooperating with the Department in the study of this project.

Engineering Data

DAM:		
	Storage:	19,250 A.F.
	Spillway:	None
	Gates:	1 - 48" diameter Slide -- Wet Tower
	Type:	Earth and Gravel Fill
	Content Measuring Device:	Tape in Tower
	Initial Cost:	$196,175.67
CANALS:		
	Supply:	4 miles Capacity 1,200 cfs
	Outlet:	Miles
R/W	Reservoir:	2,320.0 Acres Deeded
	Canals:	29.0 Acres Deeded


War Horse Project
Petroleum County
0
1
2 miles
N
Mont. 200
Paved Road
Gravel Road
Canals
Reservoir
T 16 N
T 15 N
R 24 E
R 25 E
R 26 E
R 27 E
Wild Horse Lake
War Horse Lake
Little Bear Lake
Outlet Canal
Supply Canal
Winnett Irrigation Company Ditch
Box Elder Creek
Box Elder Creek
Buffalo Creek
Buffalo Creek
Fords Creek
Fords Creek
Duck Creek
McDonald Creek
McDonald Creek
McDonald Creek
Jordan
Mont. 200
Mont. 200
Mont. 200
Mont. 244
Billings
Lewistown
Winnett
Teigen

WEST BENCH CANAL

Introduction

The West Bench Canal in Madison County, Montana, diverts water from the Ruby River. The canal, which has a capacity of 85 cfs, is about twelve miles long and shares its first mile with the Vigilante Canal. Construction of the project was financed by the State Water Conservation Board and was completed in 1950.

Water Purchase Contracts and Finances

There are water purchase contracts for 8,175 acre feet. The charges for water are $.30 for principal and $.70 for Operation and Maintenance, for a total of $1.00 per acre foot. The O&M rate has been increasing steadily over the past several years to meet rising costs. The West Bench Water Users Association has no reserve fund. The users also pay Ruby River Project principal and O&M charges.

The book charge on June 30, 1972, was $53,568.27, and water purchase contracts for future water sales total $44,442.00. There is a state investment of $9,126.27 not secured by current contracts.

Water Rights

This project obtains its water from the Ruby River Reservoir, and water rights are hereinbefore explained under the Ruby River Project.

Measuring Devices

The Department maintains a continuous recorder at the beginning of the West Bench Canal. All individual turnouts are measured with meter gates.

Operation and Maintenance

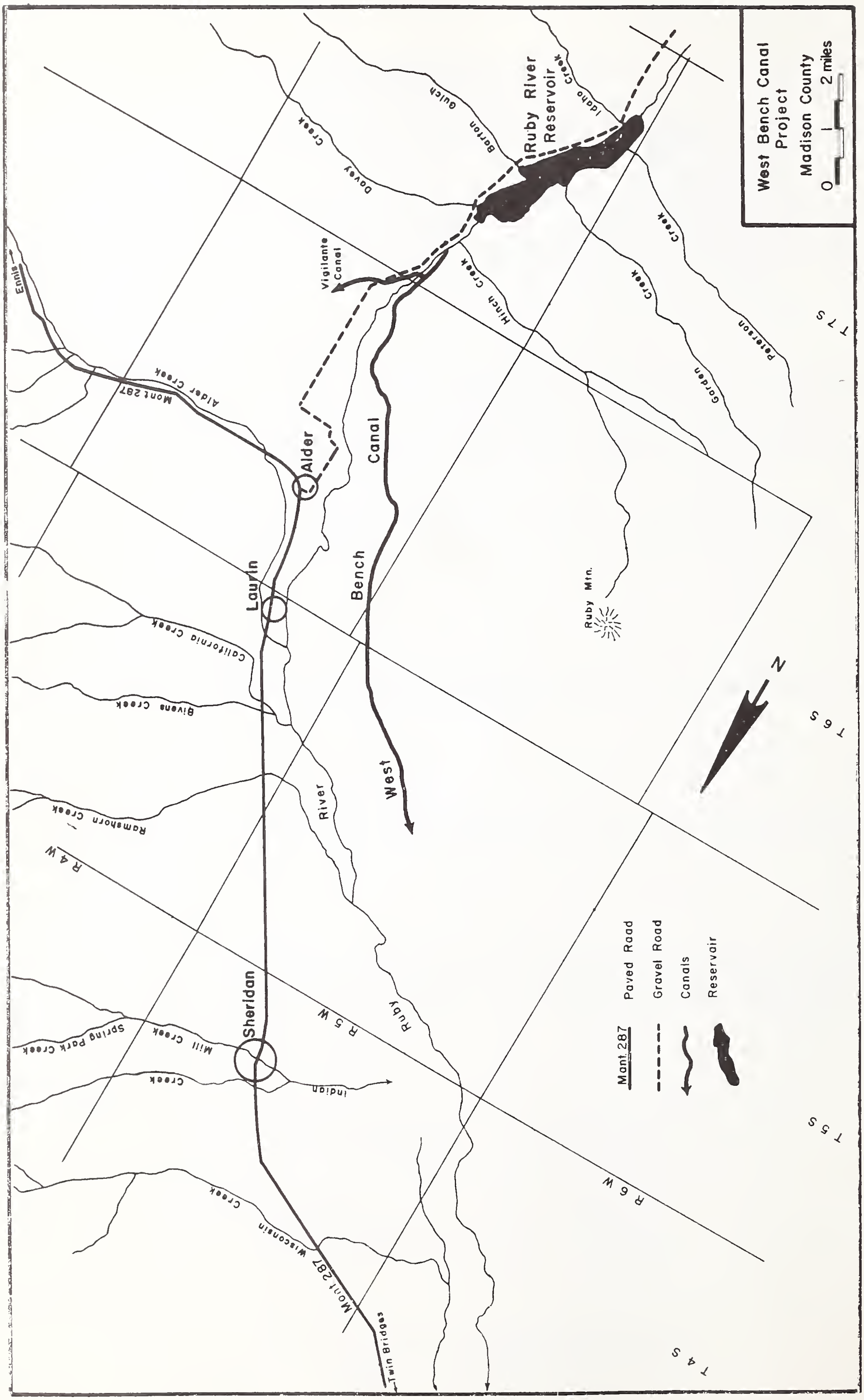
There have been very few maintenance problems on the West Bench Canal for the past several years. There was a break in the canal in 1967, and bridges have needed to be replaced from time to time. At the present there are no plans for any major repairs.

Engineering Data

DAM:	Direct Diversion
CANALS:	
Main:	0.8 miles Capacity 201 cfs Measuring Device: None
West Bench:	11.9 miles Capacity 85 cfs Measuring Device: Water Stage Recorder

R/W Canal: 161.59 Acres Deeded Partially

NOTE: R/W for West Bench Canal includes the head end of Vigilante Canal and all of the Main Canal.


West Bench Canal Project
Madison County
0 1 2 miles
Mont. 287 Paved Road
Gravel Road
Canals
Reservoir
Ruby River Reservoir
Idaho Creek
Barton Gulch
Davey Creek
Vigilante Canal
Hinch Creek
Garden Creek
Peterson Creek
West Bench Canal
Ennis
Alder Creek
Mont 287
Alder
Laurin
California Creek
Bivens Creek
Ramshorn Creek
Ruby River
Ruby Mtn.
N
Sheridan
Spring Park Creek
Mill Creek
Indian Creek
Wisconsin Creek
Mont 287
Twin Bridges
T 7 S
T 6 S
T 5 S
T 4 S
R 4 W
R 5 W
R 6 W

WILLOW CREEK

Introduction

The Willow Creek Project consists of a dam and storage reservoir with a capacity of 18,000 acre feet located about four miles east of Harrison in Madison County, Montana. There are no canals on the project, and the diversions are all private. Financing was accomplished through federal grants and loans and State General funds. Construction was completed in 1938.

Water Purchase Contracts

Eighty-five users hold 126 contracts for 8,663 acre feet of water per year on the project. The Willow Creek Water Users' Association pays $.75 per acre foot per year on a 29-year contract for construction charges and $.20 per acre foot per year for O&M, making a total charge of $.95 per acre foot. A reserve fund will be started in 1974.

As of June 30, 1972 the project had a book credit of $881.72, and future revenue from water purchase contracts is expected to total $21,903.75. Overrecovery on the project will be $22,785.47.

Water Rights

On August 20, 1935, the Department filed for all unappropriated waters of Willow and Norwegian Creeks and their tributaries.

Measuring Devices

There are fifteen turnouts on the project, two of which have Parshall flumes. All diversions are private.

Inspection Report

The dam was inspected on September 18, 1972. The report included the following notations:

1. Sagebrush should be removed from the downstream face of the dam.

2. There are old calcuim deposits in the tunnel, which has evidently been grouted in the past.

3. The sump pump in the well is not operating properly.

4. There is pitting of the stem casing.

5. Rotted wooden ladders should be removed from the tower.

6. The sidewalls and floor of the spillway are spalled and should be repaired.

7. Large rocks should be removed from the outlet. There are also small cracks in the outlet which require repair.

8. There is a small amount of seepage from the rock formation above the outlet.

Operation and Maintenance

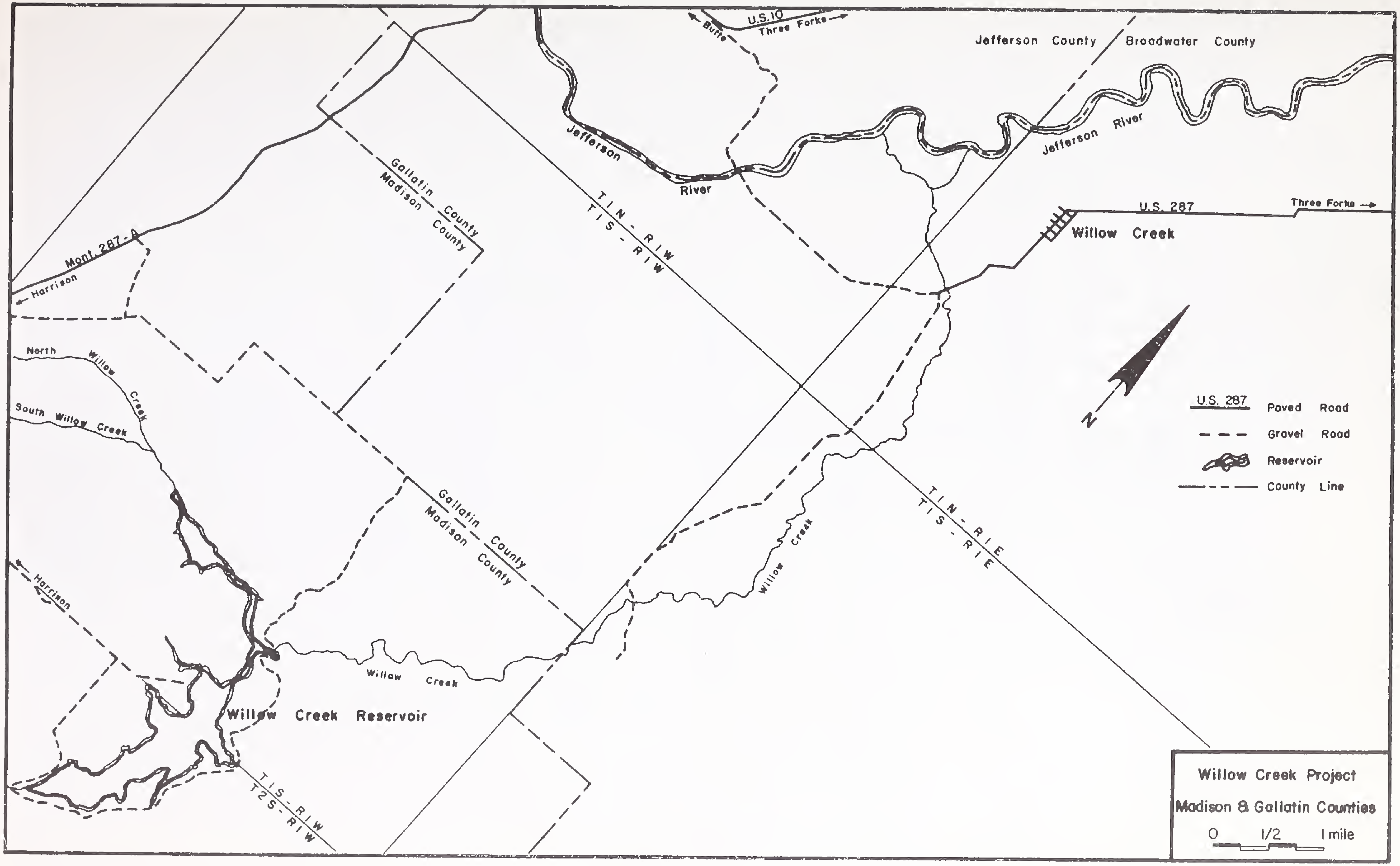
There have been few maintenance problems on this project. Immediately following the 1972 inspection, the water users removed the rock from the outlet, repaired the pitted areas, patched the spalled areas, and made plans for making the other needed repairs.

Engineering Data

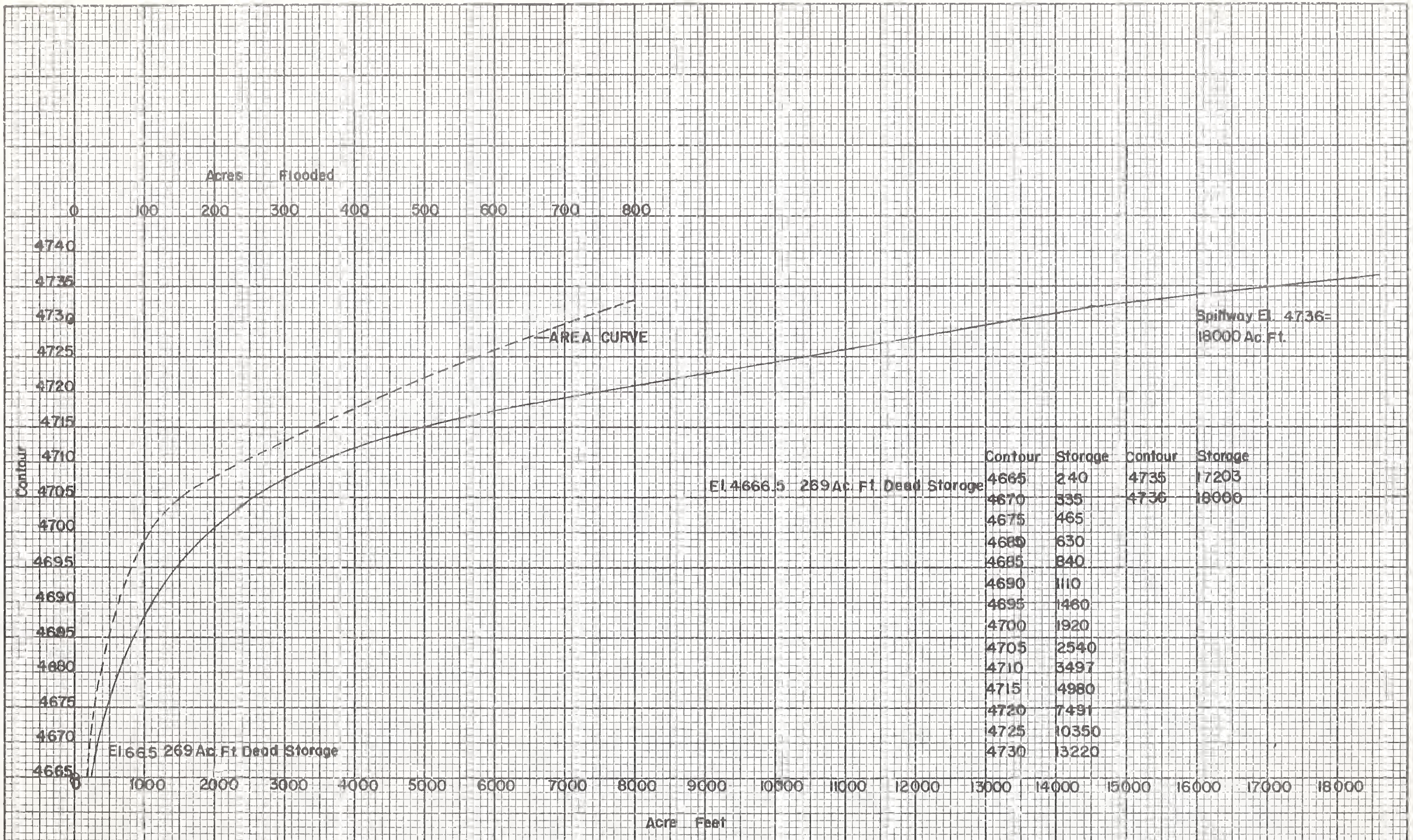
DAM:

Storage:	18,000 A.F.
Spillway:	Width 120' Capacity 8,000 cfs
Gates:	1 - 54" diameter Slide and 1 - 54" diameter Pivot Dry Tower
Height:	105'
Length:	453'
Type:	Earth Fill -- 176,000 cubic yds.
Content Measuring Device:	Cable Down Face
Initial Cost:	$329,067.79

CANALS:	None -- Private Diversions
R/W Reservoir Pool:	890 Acres Deeded
Reservoir Land:	None


Willow Creek Project

Madison & Gallatin Counties



Contour	Storage	Contour	Storage
4665	240	4735	17203
4670	335	4736	18000
4675	465		
4680	630		
4685	840		
4690	1110		
4695	1460		
4700	1920		
4705	2540		
4710	3497		
4715	4980		
4720	7491		
4725	10350		
4730	13220		

WILLOW CREEK RESERVOIR
STORGGE CURVE
MADISON & GALLATIN COUNTY PROJECT NO. 47

YELLOWATER

Introduction

The Yellowater project consists of a storage reservoir and a canal ten miles southwest of Winnett in Petroleum County, Montana. Financing for construction of the project came from State Water Conservation Board funds, which were to be repaid with 4% interest.

Water Purchase Contracts

Four users hold eight contracts for 2,000 acre feet on the project. The Yellowater Water Users' Association pays $1.00 per acre foot per year on a thirty year contract for construction charges, and O&M charges are paid on an "as needed" basis.

Book charges as of June 30, 1972 amounted to $6,170.67. Future revenue from water purchase contracts will be $18,200.00, and the Association owes $3.474.43 for improvement monies advanced on a repayment contract. This will provide an overrecovery of $15,503.76.

Water Rights

On November 27, 1935. the State Water Conservation Board filed a right for all unappropriated waters of Yellowater Creek and its tributaries.

Inspection Report

An October 12, 1972 inspection report includes the following notations:

1. The seepage below the toe of the dam presently causes no problem.
2. The tunnel is a corrugated metal pipe which has rusted out in several places. The pipe should be relined before further rusting and oxidation occurs.
3. A cap should be put over the top of the gate tower as a safety precaution.

Recent Major Repairs

In 1970, improvements were made including riprap and a gravel filter blanket for the face of the dam.

Engineering Data

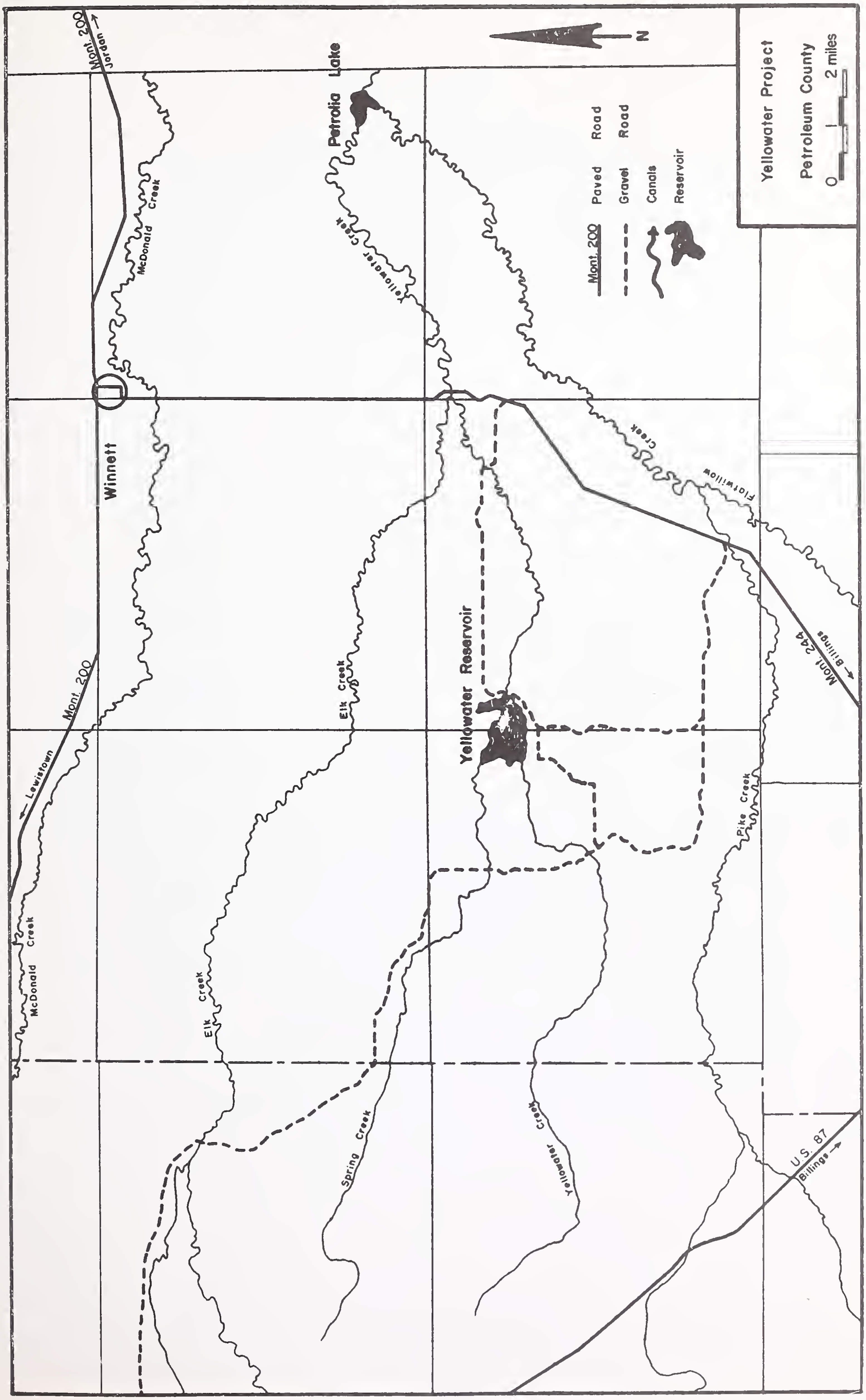
DAM:

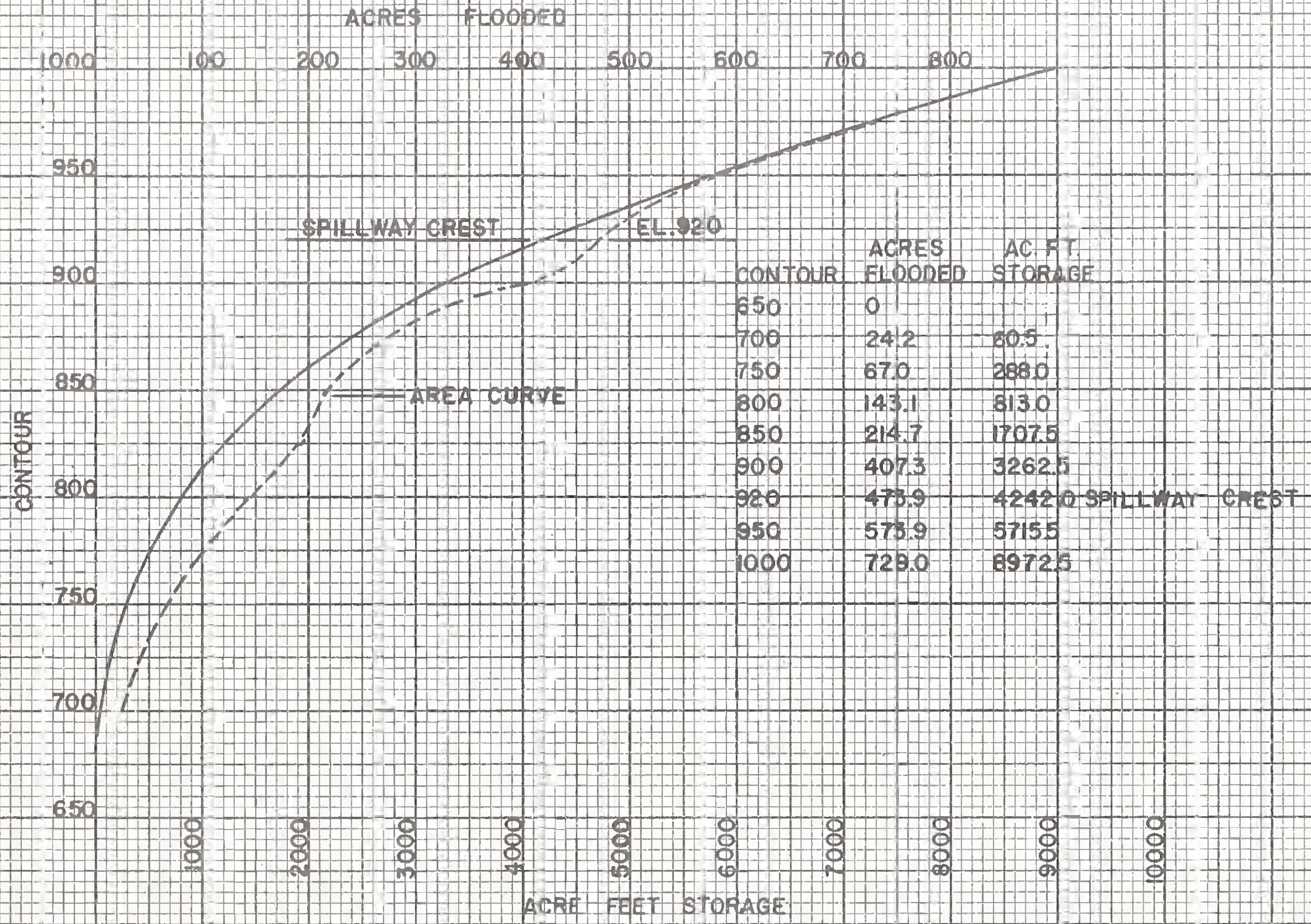
Storage:	4,242 A.F.
Spillway:	Width 100' Capacity 4,000 cfs
Gates:	1 - 42" dia. Slide -- Wet Tower
Height:	37'
Length:	2,400'
Type:	Earth Fill -- 123,700 cu. yds.
Content Measuring Device:	Tape in Tower
Initial Cost:	$102,302.45

CANALS:

None

R/W	Reservoir Pool:	473 Acres Deeded Partially
	Reservoir Land:	256 Acres Deeded Partially


Yellowater Project
Petroleum County
0
1
2 miles
N
Mont. 200 Paved Road
Gravel Road
Canals
Reservoir
Petrolia Lake
Yellowater Reservoir
Winnett
Mont. 200
Jordan →
← Lewistown
McDonald Creek
McDonald Creek
Elk Creek
Elk Creek
Yellowater Creek
Yellowater Creek
Flatwillow Creek
Spring Creek
Pike Creek
Mont. 244
Billings →
U.S. 87
Billings →



CONTOUR	ACRES FLOODED	AC. FT. STORAGE
650	0	
700	24.2	60.5
750	67.0	288.0
800	143.1	813.0
850	214.7	1707.5
900	407.3	3262.5
920	473.9	4242.0 SPILLWAY CREST
950	573.9	5715.5
1000	729.0	8972.5

YELLOW WATER RESERVOIR

STORAGE CURVE

PETROLEUM COUNTY PROJECT NO. 166

TERMINAL REPORTS

The following projects are either in a state of disuse or are functioning without State assistance. Some are tied to the State only be easements; others are tied by deeded land or by outstanding varying debts from construction charges that probably will not be recovered. The domestic supply projects, which are active and functioning properly, are the only ones other than Big Horn Tullock and Red Butte that are the purpose of which they were built. It is the opinion of the Department that it is in the State's best interest to release these projects, thereby ending State liability.

BIG HORN TULLOCK

The Department holds 34.03 deeded acres from the Big Horn Tullock Ditch Company and several easements. There is active irrigation on this project.

BLYTON

The Department holds easements only, and the project has one user.

BRADY

This is an active domestic water supply project. The Department holds deeded land and easements.

BUCKLEY

The Department holds easements only, and the project is used for storage and irrigation.

BURGESS

The Department holds easements only, and the project has one user.

COMMUNITY GRAVITY - WEST SIDE

This is an active domestic water supply project. The Department holds several easements.

FADNESS

The Department has a quit claim deed from Daniels County. However, present owners of this land are listed in Department records as Kenneth Larson, Martin O. Wang, Richard G. Handy, and Carrol J. and Darla Jerestad.

FINDLATER

The Department holds easements only and the project has been washed out.

FLETCHER

The Department holds easements only, and the project is used for irrigation and stockwater.

HALL

The Department holds easements only. This project receives limited use.

HIGHWOOD

This is a domestic water supply project. The Department holds both easements and deeds.

JONES

The Department holds easements only, and the project is used for stockwater.

LOVE

The Department holds easements only, and the project is used for stockwater.

NEISER

The Department holds easements only, and the project is used for flood control. Repairing the project for irrigation use would be excessively expensive.

NOBLE

The Department holds easements only, and the project is used for stockwater.

PARDISE

The Department holds easements only. There is possibly one user on the project.

PIERCE

The Department holds easements only, and the project receives slight stockwater use.

RED BUTTE CREEK

This is an active irrigation project, and the Department holds easements and deeds. The reservoir has lost a considerable portion of its storage capacity due to sedimentation. One of the users recently offered to buy the project, and the Montana Fish & Game Department has also shown interest in it.

RED HORSE

There is one user on this project. The Department holds one deed from the Northern Pacific Railroad for 3.80 acres. However, Department records show that the present owners are Axel and Carolyn Clausen.

RUFFATO

The Department holds easements only, and the project is used for stockwater. The State offered to return the easements to Steve Ruffato for $238.42, but this offer was refused.

RYEGATE DITCH

The Department holds easements only.

SEHM

The Department holds easements only, and the project is used for stockwater. It receives good recreational use through fishing, boating and duck hunting.

SHIPLEY

The Department holds easements only, and the project is used for irrigation and stockwater.

SWEETZER

The Department holds easements only, and the project is used for stockwater.

SWITZER

The Department holds easements only, and the project is used for stockwater.

WOLD

The Department holds easements only, and the project is used for stockwater.

Inactive projects which involve easements only include the following:

Alexander
Bishoff
Burnside
Bushell
Daniels
Davis
Francis
Hawkinson
Nickwall
Outlook
Reder
Richardson
Riley
Sinclair
Straub
Vincelette
Voss
West Fork of Poplar
Williams